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L'EXPLORATION DE LA MER
CHARLOTTENLUND SLOT — DANEMARK

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ANNALES BIOLOGIQUES

V 9-12
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VOLUME NO. IX

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Scheme for the Arrangement of the Material.

I. Review of Investigations and Essential Results.

Each Committee Chairman should here give a summary of the contributions received, i. e., a statement of the nature of the material as well as a short review of the position in the area—including the main results obtained—during the last calendar year (unless otherwise stated). This review should only in exceptional cases exceed 2 pages (about 10,000 units of type). Papers should reach the General Secretary not later than 1. June.

II. Tables and Conclusions.

A. Environment.

1. Strength and direction of currents: especially data collected during spawning seasons.
- 2 a. Temperature and salinity conditions: Tables and/or diagrams including anomalies.
- 2 b. Seasonal temperature variations at selected stations: Data including anomalies.
3. Phosphate concentration, oxygen, etc.: Tables and diagrams to include anomalies.
4. Plankton conditions: Tables and/or diagrams, especially anomalies in distribution of indicator forms, phytoplankton patches, amount of plankton and fat content.
5. Abundance of benthonic food: Data.
6. The main meteorological features of the year: Data especially as to sunlight, rainfall and direction and force of the wind.

B. The Fish.

For each species in the following order: gadoids (cod, haddock, saithe, others), flatfishes (plaice, dab, flounder, sole, witch, lemon sole, halibut, others), herring, sprat, mackerel, other pelagic fishes, eel, redfish, others.

1. Abundance and distribution of eggs and larvae.
2. Abundance of year-classes: Data derived from experimental hauls.
3. Size- and age-composition of commercial catches or landings.
4. Average length of age-groups: Data from experimental hauls and commercial catches, with standard deviations.
5. Rate of growth: Data from marking experiments and quantitative experimental hauls.
6. Rate of mortality: Data from marking experiments and quantitative experimental hauls.
7. Intensity of fishing: Data as to the fisheries considered in 3, 4, and 8.
8. Quantities landed:—
 - (a) Total catch (weight) of special fisheries,
 - (b) Percentage of large, medium and small,
 - (c) Total number of the various species,
 - (d) Size- and age-composition of commercial catches or landings.

C. Shellfish.

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North-Eastern Area.

INTRODUCTION

The sparse and scattered information we have of the distant home of our largest stocks of fish is in contrast to the great economic importance of the waters belonging to the North-Eastern Area. We can, of course, claim a fairly detailed knowledge of some of the fish populations and of some parts of this great area. But if we try to follow these problems further we find that in most cases they lead us to the waters of the north. We can say without

hesitation that in the near future investigations will have to be increased and extended to areas now unvisited by research vessels. We can also say without hesitation that the type of research work needed as well as the severity of the weather and the long distances, to be covered, require equipment of high quality.

Stone by stone we must build up our knowledge of the stability or variability of the food resources of the Arctic.

GUNNAR ROLLEFSEN.

ENVIRONMENT

Plankton.

Dry Weight and Fat Content of Plankton near Bear Island 1949-1952.

During cruises of the "Ernest Holt" to the Barents Sea since 1949 plankton samples have been collected along two lines of stations west and south-south-east from Bear Island (Fig. 1). The collections have included Hensen-net samples which have been treated for dry weight and fat determination by the methods described by WIMPENNY (1938 and 1949). Hauls were usually from 100 metres to the surface, although on cruises in 1949, in June 1950, and June and December 1952, they were from 50 metres; at stations "Nx" (40 metres), "Mx" (50 metres) and "M" (75 metres) hauls were from bottom to surface. The number of stations per cruise showed some variation as bad weather or ice sometimes prevented stations being worked.

Table 1 gives the average dry weight and fat for each cruise between March and October, expressed as milligrams per cubic metre. In obtaining the means the value at each station was weighted by the depth through which the net was hauled. In each year there was a cruise in June and these can be compared with WIMPENNY's June cruises in the North Sea, (see North Sea reports in this volume).

The June values in the North Sea were higher than those at Bear Island in each year except 1950. Of the four years at Bear Island the highest June values were in 1950 and the lowest in 1951, while in the North Sea 1952 gave the highest value with the other three years about equal.

The values in Table 1 for each cruise show a general tendency to be higher in the first two years than in the last two, and the same is true of the individual station values, some of which are plotted in Figure 2. It therefore seems worth while to present mean values to represent the summer plankton along the two sections. For samples taken between 26. April and 16. September the mean of the cruise means in milligrams per cubic metre are: —

	1949	1950	1951	1952
Dry weight....	47	54	15	22
Fat.....	13	13	2	3

The years 1949 and 1950 seem to show higher standing crops in the upper 100 metres than 1951 and 1952. It may be significant that TROUT says that in 1950 the cod otoliths showed a particularly wide ring which may

Table 1.

Date	Number of stations	Dry weight mg. perm. ³	Fat
1949			
20.—24. March.....	11	12	1
7.—11. June.....	5	32	5
12.—16. July.....	11	91	32
10.—16. Sept.....	11	17	3
1950			
16.—21. March.....	6	8	2
26. April—5. May...	12	16	2
27. May—5. June...	14	45	10
28. June—7. July...	13	56	12
4.—6. August.....	11	100	28
4.—6. October.....	13	13	2
1951			
17.—18. March.....	4	6	1
3.—13. May.....	13	14	3
13.—26. June.....	13	13	2
28. Aug.—13. Sept.	13	18	3
23.—24. October....	13	11	2
1952			
7.—10. March.....	12	8	1
26.—28. April.....	13	14	2
4.—20. June.....	15	24	4
25.—26. August.....	8	26	3

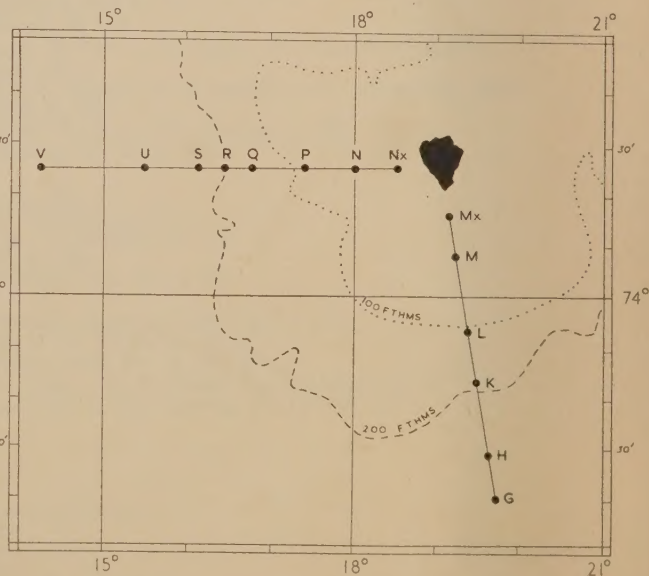


Figure 1. Stations used in dry weight and fat determinations.

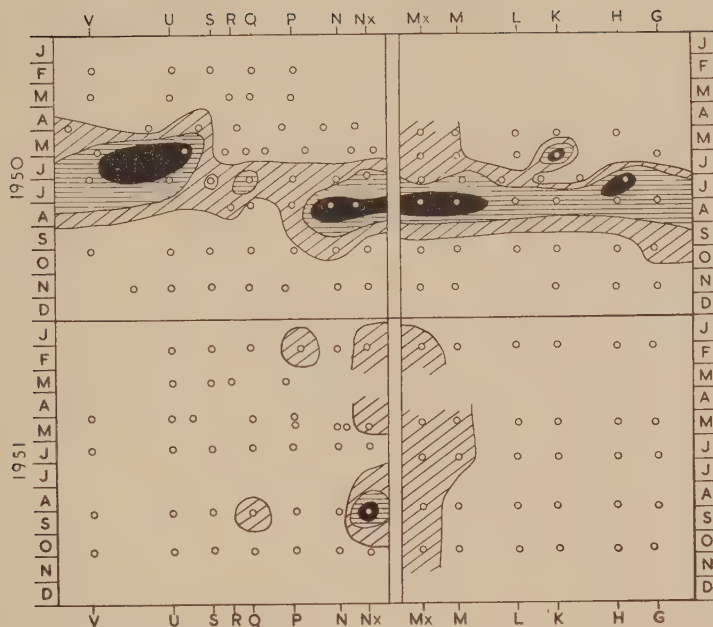


Figure 2. Dry weight of Hensen-net samples contoured at 20 mg. per m.³ (oblique lines), 50 mg. per m.³ (horizontal lines) and 100 mg. per m.³ (black lines).

be associated with good feeding conditions round the Bear Island bank (personal communication). It must be admitted that the dates of the cruises differed in the four years and it is possible that the main peaks of production were missed in some years, but even if the highest cruise value for each year is omitted the conclusion is unchanged.

In Figure 2 the values for dry weight for the years 1950 and 1951 are contoured and can be compared with those similarly presented by WIMPENNY for the Flamborough Line in the North Sea in *Annales Biologiques*, Volumes IV, V, VI, and IX. The observations in 1949 and 1952 are too few to be usefully presented by this method. The contours for 1950 show a high concentration of plankton over the deep water in May-July, and in the colder, shallower water near Bear Island in August. In

July 1949 dry weights of over 100 mg. per m.³ were obtained at stations "U", "R", "L", "K", and "H". In 1952 no values over 50 mg. per m.³ were found.

Conclusions.

1. Plankton near Bear Island was richer in 1949 and 1950 than in 1951 and 1952.
2. The maximum over the deep water was in May-July, and in shallower water in August.

J. CORLETT.

References.

- WIMPENNY, R. S., 1938. "A routine method for the estimation of fat in plankton and its application to herring tissues". *Journ. du Cons.*, 13, 338-348.
- WIMPENNY, R. S., 1949. "The dry weight and fat content of plankton". *Ann. Biol.*, 4 (1947), 89-90.

THE FISH

German Fishery Research Work.

In recent years, the German fishery in the area has undergone considerable changes. While in the first post-war years the Bear Island region still held a prominent position, since 1948 the fishery here has declined perceptibly and has ceased almost completely since 1950. The Barents Sea, however, with hardly any fishing in the beginning, has now become more important, but the fishery has changed its character. On the one hand, the eastern fishing grounds which chiefly used to be fished, are today closed, so that the area off the North Cape now predominates and only a few cruises are extended to the ground of the Skolpenbank—Northdeep. On the other hand the percentage of haddock in the catches has not only declined and that of the cod risen accordingly, but a very considerable increase in the proportion in the catches of the redfish has taken place so that this fish, even in the Barents Sea, has become the most prominent species.

The region off the Norwegian coast has lost little in importance, but catches have generally been smaller, excepting the greater percentages of saithe in the winter catches. The fishing season has been somewhat extended, and the highest catches are now made in mid-winter. Furthermore fishing is carried out not so much off Andenes, formerly the most important ground, but more to the south on the Røstbank and, to an increasing degree, further north until the North-West flat and the Fugløbank. Since 1951, the boundary line of the "Barents Sea", as used in the German fishery statistics, has been transferred from 26° E. Lat. to 22° E. and now includes the North Cape, Fruholmen and Tromsøflat grounds. The former boundary line intersected an important fishing ground. Since 1950 the "Svinøy" (Romsdalbank) ground is also being fished for a few weeks in spring.

The total catch of the German fishery in the North-Eastern Area is at present somewhat more than half that of the last pre-war year. The yield — calculated as catch per fishing day — can only be compared with some reservation; on the one hand the fishing effort of today's larger trawlers has increased, but

Table 1. Total German Fishery in the North-Eastern Area and Percentage of the Total German Trawler Fleet.

(in brackets, share in the groundfish catches, i.e., herring excepted) ¹⁾.

Year/Area	Cruises	%	Fishing days	Catch in tons	%
1938					
Norwegian coast..	803	12	5317	91755	17 (25)
Barents Sea.....	553	9	3365	55249	10 (15)
Bear Island + Spitsbergen	358	6	2256	41195	7 (11)
Total.....	1714	27	10938	188199	34 (51)
1946					
Norwegian coast..	4	0	(30)	1981	1 (2)
Bear Island.....	115	6	876	16729	10 (21)
Total.....	119	6	906	18710	11 (23)
1947					
Norwegian coast..	77	3	561	8683	4 (7)
Barents Sea.....	37	2	288	5719	3 (5)
Bear Island.....	133	6	1123	16145	8 (14)
Total.....	247	11	1972	30547	15 (26)
1948					
Norwegian coast..	296	10	2535	38847	16 (30)
Barents Sea.....	105	4	850	15055	6 (12)
Bear Island.....	42	1	344	5214	2 (4)
Total.....	443	16	3729	59116	24 (47)
1949					
Norwegian coast..	286	8	2624	35105	10 (20)
Barents Sea.....	123	4	1045	18620	5 (10)
Bear Island.....	59	2	475	9175	3 (5)
Total.....	468	14	4144	63900	19 (36)
1950					
Norwegian coast..	421	13	3973	64368	17 (44)
Barents Sea.....	93	3	857	15191	4 (10)
Bear Island.....	5	0	49	802	0 (1)
Total.....	519	16	4879	80361	22 (55)
1951					
Norwegian coast..	413	12	4262	67424	14 (26)
Barents Sea.....	197	6	1531	34545	7 (13)
Bear Island.....	20	1	169	3946	1 (2)
Total.....	630	18	5962	105915	22 (41)
1952					
Norwegian coast..	367	12	3804	61655	13 (22)
Barents Sea.....	174	6	1486	31937	7 (11)
Bear Island.....	14	0	123	2039	0 (1)
Total.....	555	18	5413	95631	20 (34)

¹⁾ In contrast to the official German fisheries statistics the "mixed cruises" and the landings in foreign ports are included. Thus the actual fishing and catch is recorded, but not with absolute reliability.

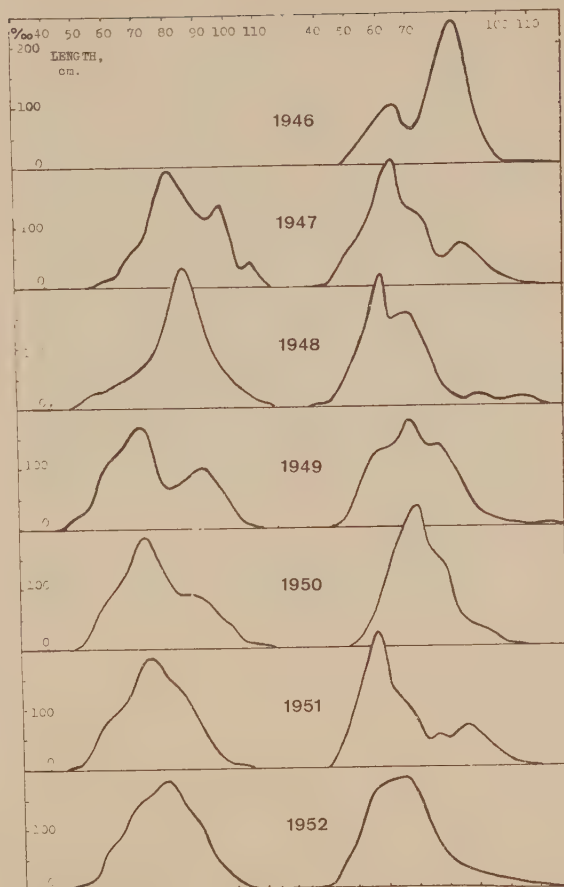
Table 2. Catch per Fishing Day by German Trawlers (in 100 kg.).

Year	1938	1946	1947	1948	1949	1950	1951	1952
Norwegian coast								
Cod.....	62	—	(19)	52	36	31	29	28
Haddock...	32	—	(1)	41	31	28	12	10
Saithe.....	28	—	(47)	24	29	56	51	72
Redfish....	45	—	(87)	36	35	38	78	42
Total catch	171	—	(155) ¹⁾	153	135	162	178	162
Barents Sea								
Cod.....	86	—	184	166	142	117	90	42
Haddock..	57	—	10	3	21	3	11	9
Saithe.....	2	—	0	4	11	4	15	7
Redfish....	7	—	0	1	4	30	109	156
Total catch	162	—	199	177	184	163	233	220
Bear Island								
Cod.....	122	184	112	147	173	137	122	21
Haddock..	15	1	2	1	4	13	1	2
Saithe.....	8	1	1	7	2	8	1	1
Redfish....	44	4	25	2	13	17	120	129
Total catch	197	192	144	160	199	183	250	157

¹⁾ The fishing started only in April.

on the other hand the local distribution of the fishery has changed. However, one thing has clearly emerged; viz., the small and varying haddock yields and the large increase in redfish. Thus this latter fish has become the chief object of the fishery, and since 1951 it takes first place in the landings from the Barents Sea, greater than either cod or haddock.

Cod. The market analyses have been continued since 1946; each year some thousand



Norwegian Coast

Barents Sea
Bear Island**Figure 3. Cod.**

Length composition of the catches.

Table 3. Age Composition of Cod, German Landings.

A. From the Barents Sea — Bear Island.
(Percentages)

B. From the Norwegian Coast.
(Percentages, not including the last winter-ring).

Age-group	1946 ¹⁾	1949	1950	1951	1952	1950	1951	1952
II.....	—	0	—	—	—	—	—	—
III.....	0	2	0	12	7	—	—	—
IV.....	7	7	3	36	21	0	1	1
V.....	16	11	9	18	23	3	4	2
VI.....	6	37	14	10	14	18	8	7
VII.....	6	24	36	6	13	35	25	13
VIII.....	11	8	16	10	8	13	11	20
IX.....	45	4	9	3	5	7	14	12
X.....	6	2	5	3	2	6	10	15
XI.....	1	1	2	1	1	5	6	13
XII.....	2	2	6	1	1	6	4	8
XIII.....	—	—	—	—	—	2	10	3
XIV.....	—	—	—	—	—	2	2	5
XV+.....	—	—	—	—	—	3	5	1

¹⁾ According to examinations made by Dr. ARNO MEYER, his age determinations included up to 1950.

length measurements are being made and also 300—1000 age determinations which are converted according to length distributions.

In the Bear Island region the old and strong 1937 year-class still constituted in 1946 the bulk of the catches, supplemented by the 1941 year-class; in the Barents Sea, however, the 1943 year-class dominated since 1949, and since 1951 the 1947 year-class proved to be the strongest. Off the Norwegian coast the highest percentages were, in the beginning, attained by the 1942 year-class, although it did not prove especially strong elsewhere; later on, until 1952, the 1943 year-class here also took the lead, seconded by the classes of 1941 and 1937.

The curves of the length distributions of cod from the Barents Sea show accordingly a peak — decreasing from 1946 to 1949 — for the relatively older fishes of 80 cm. and over. In 1946 a new wave of younger fishes appears which is replaced in 1951 by a third and still stronger one. Off the Norwegian coast the first wave of young fishes is not clearly perceptible before 1949, and the second one has not yet appeared in 1952, but it is expected in one of the coming years.

Haddock. For the first post-war years only length measurements are available. During the period 1946—1949 they indicate a wave of relatively old fish with a length increasing from less than 70 cm. to almost 80 cm. As in the cod, the average age was gradually decreasing; in 1951 a third wave of young fish of about 40 cm. length is slightly indicated, and in 1952 it dominated.

In the haddock also the decreasing average age becomes evident off the Norwegian coast after only a delay of a few years, and this

Table 4. Age Composition of Haddock, German Landings.

Age-group	A. From the Barents Sea (Percentages)		B. From the Norwegian Coast (Percentages, not including the last winter-ring.)		
	1951	1952	1950	1951	1952
II.....	1	0	—	—	0
III.....	21	8	1	0	7
IV.....	11	77	2	2	4
V.....	22	6	15	12	26
VI.....	13	6	21	20	15
VII.....	8	2	21	23	17
VIII.....	6	1	17	19	15
IX.....	6	1	8	11	8
X.....	5	0	5	6	2
XI.....	3	—	4	4	3
XII+.....	4	0	6	3	3

second wave remained with minor changes until 1952.

Age determinations were restarted not before 1950. In the Barents Sea the 1946 and 1948 year-classes were predominant; this was so much more obvious owing to the 1947 year-

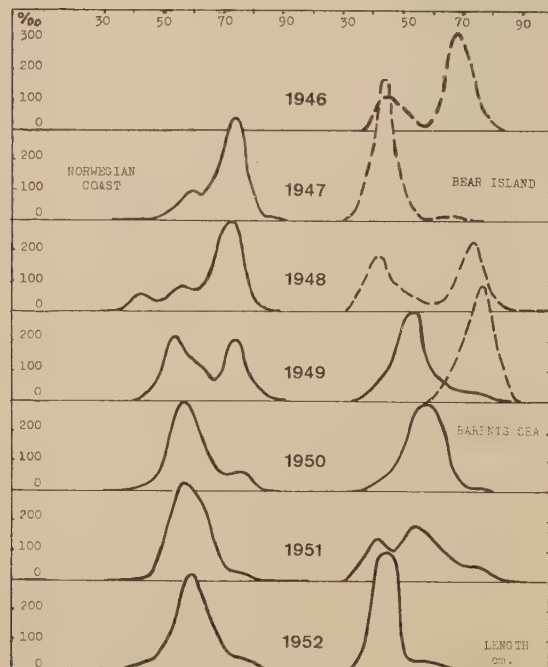


Figure 4. Haddock.

Length composition of the catches.

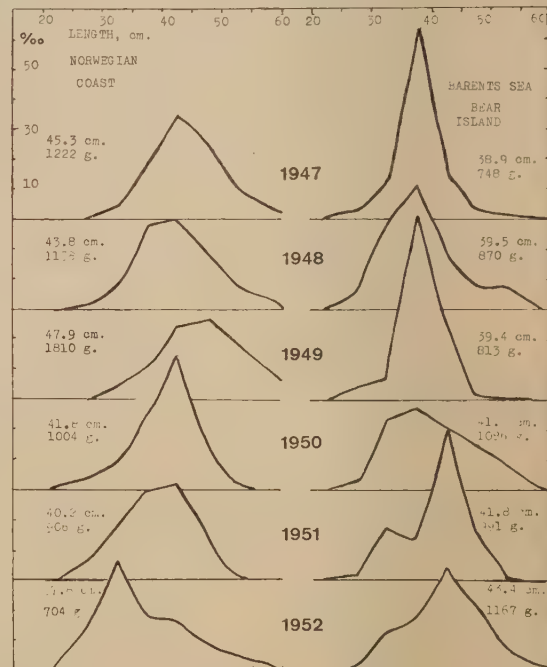


Figure 5. Redfish.

Length composition of the catches.

class being exceptionally weak. In 1952, however, more than three quarters of the catches consisted numerically of the 1948 year-class — fluctuation the strength of which has never before been observed in the haddock stock of this area. Off the Norwegian coast the haddock were somewhat older. In 1950 and 1951, the 1943 year-class was only slightly conspicuous, in 1952 the 1946 year-class outweighed by far the adjoining older and younger classes; the 1948 year-class was as yet still weakly represented, but its later predominance can already be guessed.

Redfish. The length composition of the landed redfish shows strong fluctuations, and not only do the sexes occur separately on occasion, but also various races are recorded; the market measurements have, therefore, only

been worked up provisionally. A very important fact, however, could be established, i.e., that simultaneously with the strong increase in the stock recorded in the area off the North Cape and in the Bear Island Deep, the proportion of small fishes between 30 and 40 cm. has increased very remarkably. Thus, the decrease in average length and average weight noticed since 1949 is not caused by the larger fishes being fished out, but it is due to the small fish which formerly did not occur in the catches, and which have now approached the coast from north of Lofoten to Finmark and Bear Island Deep, and which thus come into the range of fishery. These small fish represent possibly a kind of oceanic stage of life.

JOH. LUNDBECK.

North-Western Area.

INTRODUCTION

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Research vessels from Denmark, England, Iceland, Norway and Scotland have operated in the area during the year, and many very valuable observations have been obtained during operations by several other vessels, both fishery inspection vessels and commercial fishing vessels (cf. the Administrative Report, Rapp. et Proc. Verb., Vol. No. 135, 1953).

Environment.

The hydrographical data for 1952 are of a similar extent as in the preceding year.

The study of surface temperature anomalies is continued and shows generally a rise (but not evenly over the region) in temperature in the greater part of the North Atlantic north of 55°N. Lat., and the temperature is still above the average for the period 1876—1915 as standard. In the Faroe area a drop from 1951 to 1952 is recorded.

Moreover Mr. JENS SMED gives a general survey of his researches on the anomalies of the surface temperature in the North Atlantic published in *Annales Biologiques* since 1947 (Vols. II—VIII). The warm periods about 1873—1882 and from about 1920—25 to the present day are very conspicuous, especially in the areas off West and Southwest Greenland, round Iceland and the Faroes. The lack of observations from 1939—45 is very

obvious, but indications are at hand that the present warm period is now probably petering out (cf. Figures 4—5).

Hydrographic surveys are presented from the following important areas: Faroe-Shetland Channel, north of the Faroes, Faroes to East Greenland, north and east of Iceland to Jan Mayen and Davis Strait. The surveys are mostly from the months of June and July, but the area north of the Faroes (the tongue of the East Icelandic Arctic Current) is covered by observations in March, May, June, July and November. The alterations during the seasons in the extent of this current, so important for the herring migrations, begin to crystallize, but operations during the winter are badly needed. Moreover a close study of the warm Atlantic tongue along 11°W. Long. is very important for the understanding of the Norway-Iceland herring migration. Some notes are given, in the reports on hydrography, on the occurrence of herring in relation to temperature etc. during several months.

The summer observations in the area south of Iceland (between Faroe and East Greenland), north of Iceland and off West Greenland show that this season, 1952, was, at any rate, a cold one. Observations during the next few years in these areas may show whether this trend is continued or whether the warm period is not yet declining. It would be of the utmost interest if the various countries operating vessels in the area could procure material from the routine sections at other seasons than the summer months June-July.

In connexion with hydrographic observations from West Greenland Mr. HERMANN points out the very interesting strong correlation between the strength of the year-classes of cod and the bottom temperature on Fylla Bank in the month of June. Temperatures higher than about 1.8°C. (to about 3.8°C. as the highest on record) are followed by good or very good year-classes; the poor year-classes so far known have been born and developed in periods with temperatures below about 1.8°C. This clear and simple observation is probably of far-reaching value for future forecasts in this and other cod areas and a close study of this observation is worth while (physiological conditions, developmental rate of larvae etc.).

The **Plankton** researches were carried out by Scotland in the Faroe Channel and at the Faroes six times during the year; in addition a survey along the south coast of Iceland was made in September. The report describes in detail the conditions in the Channel between the Faroes and Shetland-Orkney-NW. Scotland. Plankton taken during the year in the area by "Dana" and other vessels will eventually be worked up.

The Fish.

Eggs and Larvae. A survey of the abundance in the Faroe area of eggs of haddock and of larvae of haddock, cod, whiting and saithe is given. According to the egg production the years' brood of haddock is estimated to be midway between the year broods of 1950 and 1951. The estimation of abundance of larval stages of the different gadoid species seems, however, rather uncertain this year.

Herring — see special report from the Herring Committee.

Cod. Estimation of strength of year-classes is given for the Iceland and West Greenland areas.

In Iceland waters the 1942 year-class is still dominating in the spawning stock, but for 1953 the 1945 year-class is predicted to take the lead. Also year-classes 1946 and 1947 are promising. The predictions from this area seem very reliable, and it seems possible to explain some slight discrepancies between the calculated and observed fluctuations. The stock is, however, rather weak as a whole compared, e.g., with the stock in the twenties.

From Greenland waters very extensive material from commercial fishing vessels from Denmark, England, Germany, Iceland, and Norway has been examined. The area from Cape Farewell to Disko Bay is covered by trawl and long-line catches and the dominating year-classes are 1942, 1945 and 1947, the first especially to the north and in deeper water, the second on the banks and to the south; the third is very rich but so far, owing to the small size of the individuals, of minor importance in the off-shore fishery. Much valuable information is reported on the cod fishery during the season, the catch in relation to temperature, catch per unit of effort, gear used and locality, growth, etc. The several studies show the importance of this stock of cod to the European fishery.

Migrations of cod in both Iceland and Greenland waters are studied by marking experiments. A few long-distance migrations from

Iceland to Norway are recorded and supplement those previously known.

Haddock. Extensive studies are carried out by Scotland in the Faroe area. Several good year-classes compose the catches and the commercial catches per 100 hrs. are practically the same as in 1951. In the Iceland area the haddock of Faxa Bay has been sampled and it is shown that during June-August 1952 the 1949 year-class constituted as much as ca. 90 % of the catches.

Saithe. Age-assessment of this fish has been carried out as in previous years at North Iceland; the very rich 1945 year-class has now left this area, evidently because maturity has been reached; a new year-class, 1947, is now predominant. It should be pointed out in this connexion that this, 1947, year-class is very important in several other species of fish, distributed all over the North Atlantic from the Baltic to Greenland waters.

Lemon Sole. The stock is declining in the Faroe waters, as previously pointed out. (The 1946 year-class is still predominant in number). It is accordingly of much value to follow the composition of the stock of this valuable fish in this and other parts of the whole distribution area.

Redfish. Reports are given from both the Iceland and the West Greenland areas. From West Iceland interesting records of catches are given, showing a decrease in size during 1950 to 1952, and moreover a decrease in catch per day from June to August in 1952. So far we have no explanation of these facts. The occurrence of *Argentina silus* in the redfish catches as a commercially important part is worth stressing. From the West Greenland banks German trawl catches show great quantities of redfish, especially from Lille Hellefiske Bank, in a depth of about 300 m. in June; sizes between 30 and 55 cm. were most numerous. We are in need of much more information on this fish which is of increasing importance.

Rare Fishes. Several records of rare or exotic fishes are given from Greenland, Iceland and Faroe waters, some are even species never recorded before. The cause of this seems partly to be the extension of trawling to new and deeper localities, and partly to the influence of the present climatic change. For the study of the influence of climatic changes faunistic records are of great value and publication of even single and stray observations is recommended.

Å. VEDEL TÅNING.

ENVIRONMENT

Hydrography.

Monthly Anomalies of the Surface Temperature in Areas of the northern North Atlantic in 1952.

As usual the Danish Meteorological Institute has, in 1952, collected a large number of observations from Danish ships of the surface temperature in the northern North Atlantic.

On the basis of these data and a minor collection of German origin the anomalies, using RYDER's grand monthly means for the period 1876—1915 as standard, have been evaluated for each month and each 1°-square. These anomalies were then averaged over the areas indicated in Figure 1.

The results are given in Table 1 where the monthly anomalies are recorded together with the numbers of observations on which they are based. In the last column of the table the monthly anomalies for each area have been averaged over the year.

Table 1 shows that positive anomalies are still predominant in nearly all the areas. The distribution of the anomalies over the whole region is seen from Figure 2 where the yearly anomalies, given in the last column of Table 1, have been entered. It is seen that anomalies of the order $\frac{1}{2}^{\circ}\text{C.}$ or more are limited to a region to the south or south-east of Greenland (areas C, D and E) and an area surrounding eastern Iceland (area I).

The average over all areas of the yearly anomaly is about 0.35°C. against 0.2°C. in

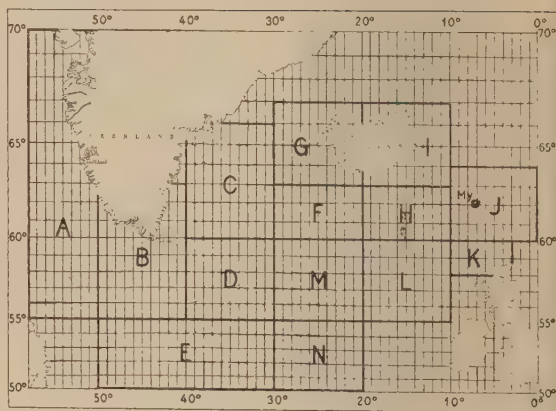


Figure 1. Location of areas and station My.

1951. The rise of temperature since 1951 is, however, not evenly distributed over the region. In each of the areas D, E and N temperature has risen more than $\frac{1}{2}^{\circ}\text{C.}$, in area E almost nearly 1°C. since 1951, whereas temperature has fallen a little in the areas A, H, I, and J. In fact the rise of temperature since 1951 varies very regularly in the region. The highest values lie in an area to the south from where the values fall off in the various directions and change into negative values in the north-western and north-eastern parts of the region, as shown in Figure 3.

Table 2 gives grand monthly means of the surface temperature at Myggenæs, Faroes (station My in Figure 1), during the period

Table 1. Monthly Anomalies ($\Delta^{\circ}\text{C.}$) and Numbers (n) of Observations of the Surface Temperature in the Areas A-N (see Figure 1) during 1952.

Area	Jan.		Feb.		March		April		May		June		July		August		Sept.		Oct.		Nov.		Dec.		Average of Δ -val.
	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	Δ	n	
A....	—	—	—	—	—	—	0.1	15	0.6	57	0.5	134	-0.1	273	0.5	70	1.2	42	-0.3	46	-0.4	9	—	—	0.3
B....	—	—	—	—	0.2	42	-0.5	100	0.3	97	0.3	65	-0.1	99	0.3	50	0.0	44	-0.1	79	0.6	33	1.8	1	0.3
C....	—	—	—	—	-0.1	32	0.1	28	-0.2	47	0.1	42	0.1	72	1.3	40	1.1	73	1.6	63	1.4	7	—	—	0.6
D....	1.5	4	-0.2	1	-0.2	66	-0.2	64	0.1	58	0.2	39	-0.1	39	1.2	45	1.3	19	1.1	58	0.8	32	0.7	4	0.5
E....	0.8	49	0.3	31	1.1	27	-0.7	45	1.3	48	2.1	38	1.7	37	2.9	30	2.8	31	0.9	26	1.6	55	1.9	34	1.4
F....	-3.6	2	2.7	1	-0.3	62	-0.1	63	-0.3	74	-0.3	77	-0.3	87	-0.1	28	0.2	64	0.6	53	0.4	42	0.3	23	-0.1
G....	-0.9	6	1.2	13	0.2	12	0.4	9	0.3	23	0.5	10	-0.2	13	-0.6	29	-0.1	18	-0.2	20	1.0	10	1.0	7	0.2
H....	-0.2	38	0.4	44	-0.3	103	0.3	86	0.5	118	-0.1	118	0.0	114	-0.6	115	-0.2	122	0.0	134	0.4	77	0.7	37	0.1
I....	0.3	8	-0.1	8	0.0	9	1.5	6	0.8	15	-0.4	23	0.4	21	0.1	20	0.7	9	1.3	9	1.4	4	0.6	4	0.6
J....	0.3	30	0.6	31	0.4	53	0.5	54	0.9	65	-0.9	117	-0.3	80	-0.2	87	-0.4	76	-0.1	55	0.1	67	0.3	52	0.1
K....	0.3	32	0.2	34	0.5	48	0.6	55	1.1	66	-0.3	44	-0.1	51	-0.1	39	-0.8	50	-0.1	53	0.0	49	0.6	27	0.2
L....	0.5	31	0.2	30	0.2	39	-0.2	41	0.8	37	-0.2	33	0.0	26	0.5	15	0.3	13	0.3	42	0.5	32	1.0	14	0.3
M....	-0.4	38	0.1	22	-0.5	35	-0.8	44	-0.5	52	0.0	30	-0.1	20	0.2	32	1.7	10	0.5	48	1.0	44	0.8	19	0.2
N....	-1.4	3	—	—	-0.3	1	-1.7	1	—	—	—	—	1.9	10	1.8	8	2.4	4	-0.4	10	—	—	—	—	0.3

Table 2. Grand Monthly Means of the Surface Temperature (°C.) at Myggenæs, Faroes (My in Figure 1) during the Period 1914—50 and Deviations for 1952 from these Means.

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Means 1914—50.....	6.3	6.0	5.9	6.3	7.1	8.2	9.3	9.8	9.7	9.1	7.9	7.0
Deviations 1952.....	-0.3	-0.5	-0.1	0.1	0.0	-0.8	-0.7	-0.7	-0.7	-0.6	-0.5	-0.5

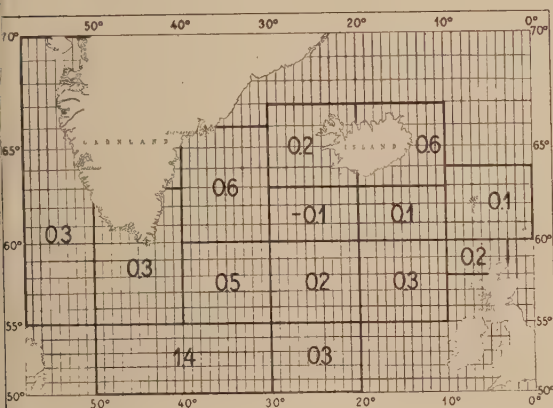


Figure 2. Yearly anomalies of surface temperature (°C.).

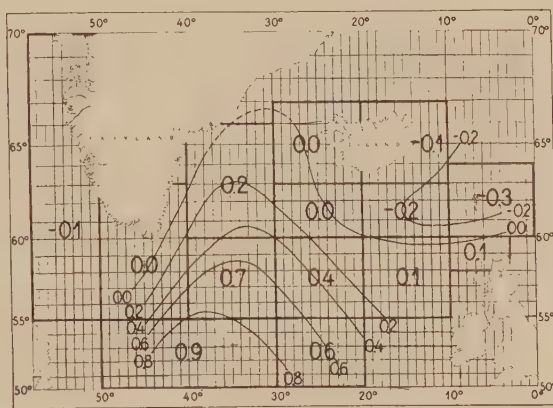


Figure 3. Rise of temperature (°C.) from 1951 to 1952.

Table 3. Yearly Anomalies (°C.) of the Surface Temperature in the Areas A-X (see Figure 1) during the Period 1876—1952.

	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	Area I	Area J	Area K	Area L	Area M	Area N
1876...	0.0	0.0	0.0	-0.3	0.0	0.1	0.6	0.2	0.0	0.1	-0.3	-0.2	-0.2	0.0
77...	1.1	0.9	0.4	0.4	0.0	0.1	0.7	0.1	0.2	0.0	-0.4	0.0	0.0	—
78...	0.3	0.8	0.8	0.4	0.8	0.2	0.2	0.4	0.0	0.8	0.6	0.4	0.4	—
79...	0.4	0.4	0.2	0.6	0.1	0.1	0.3	-0.1	0.4	-0.2	-0.4	-0.3	0.0	—
80...	0.7	0.9	—	0.8	0.8	1.3	1.4	1.2	1.0	0.8	0.6	1.0	0.6	1.0
1881...	0.0	0.3	0.7	0.4	-0.4	0.4	1.1	0.5	0.0	0.2	0.3	0.3	0.3	-0.4
82...	0.1	-0.1	—	0.0	-0.6	-0.2	-0.5	-0.1	-1.0	0.4	0.4	0.1	-0.4	-0.5
83...	0.0	0.0	0.3	-0.2	-0.2	-0.3	0.2	0.0	0.3	0.3	0.0	0.0	-0.3	0.0
84...	-0.6	-1.0	-0.6	-1.1	-1.2	-0.5	0.0	-0.2	0.5	0.3	0.3	-0.2	-0.8	-1.1
85...	0.3	0.1	—	-0.5	-0.4	-0.6	-0.5	-0.5	-0.3	-0.2	-0.4	-0.5	-0.6	-0.7
1886...	0.3	0.2	-0.6	0.0	0.7	-0.5	-0.7	-0.5	-0.8	-0.5	-0.3	-0.3	-0.1	0.0
87...	-0.1	0.0	-0.4	0.5	1.0	0.0	-0.9	-0.3	-1.5	-0.7	-0.1	0.1	0.5	0.4
88...	1.0	0.7	0.4	1.0	1.5	0.2	-1.1	-0.2	-1.3	-0.7	-0.4	0.2	0.8	1.2
89...	-0.1	-0.1	0.2	0.3	1.0	0.4	0.5	0.4	0.9	0.3	0.3	0.4	0.7	0.7
90...	0.0	-0.2	0.3	-0.1	0.2	0.1	0.3	0.1	0.4	0.2	0.2	0.0	0.1	0.4
1891...	0.1	0.2	0.7	0.2	0.6	0.3	0.2	0.2	0.0	-0.3	-0.2	0.0	0.5	0.7
92...	0.1	0.5	1.2	0.7	0.8	-0.1	-0.8	-0.6	-1.3	-0.7	-0.6	-0.3	0.2	0.7
93...	0.2	0.5	1.4	1.2	0.9	0.6	0.7	0.5	0.5	0.2	0.3	0.6	1.0	1.1
94...	-1.2	-0.8	0.4	0.1	-0.1	0.2	0.5	0.2	1.2	0.3	0.4	0.2	0.2	0.1
95...	0.6	0.8	0.6	0.6	0.1	0.3	0.4	0.1	0.2	0.0	0.0	0.2	0.3	0.3
1896...	-0.6	-0.4	-0.3	0.2	0.6	-0.1	0.1	0.0	-0.7	0.0	0.1	0.0	0.4	0.5
97...	-0.1	-0.1	0.3	0.3	0.2	0.1	0.1	0.0	-0.2	-0.3	0.0	0.0	0.2	0.3
98...	-0.7	-0.4	-0.2	0.0	0.5	-0.3	-0.1	-0.2	0.2	-0.2	0.3	0.2	0.2	0.5
99...	0.5	0.2	0.1	0.0	0.5	0.2	-0.2	0.0	0.5	0.1	0.3	0.3	0.2	0.5
1900...	0.8	0.3	0.3	0.1	0.2	0.2	0.0	0.2	0.4	0.1	0.3	0.8	0.6	0.4

Table 3 continued.

	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	Area I	Area J	Area K	Area L	Area M	Area N
1901 ...	-0.1	-0.2	-0.3	-0.1	-0.1	-0.3	0.3	0.0	0.3	0.3	0.2	0.0	-0.1	-0.2
02 ...	0.2	0.5	0.4	0.6	0.8	0.2	-0.2	0.0	-0.2	-0.3	-0.3	0.2	0.7	1.0
03 ...	-0.1	0.1	0.1	0.0	-0.5	-0.4	-0.5	0.0	-0.1	-0.2	-0.2	-0.1	-0.1	-0.3
04 ...	-0.2	0.5	0.4	-0.7	-1.1	0.0	0.0	0.1	0.5	0.1	0.0	-0.2	-0.6	-0.8
05 ...	0.4	-0.3	-0.6	-0.6	-0.7	-0.5	-0.2	0.0	0.1	0.0	0.0	-0.2	-0.4	-0.6
1906 ...	-0.2	-0.5	-0.5	-0.4	-0.3	-0.4	-0.3	-0.3	-0.4	-0.4	-0.3	-0.5	-0.4	-0.3
07 ...	-1.0	-0.7	-0.3	-0.8	-0.3	-0.4	-0.7	-0.4	-0.8	-0.5	-0.6	-0.7	-0.5	-0.4
08 ...	-0.4	-0.6	-0.2	0.6	0.2	0.4	0.1	0.1	0.2	0.1	-0.2	-0.2	-0.3	-0.2
09 ...	0.2	0.2	0.4	0.2	0.6	0.3	0.0	-0.1	0.5	0.0	-0.3	0.0	0.1	0.5
10 ...	0.1	-0.2	-0.5	-0.2	0.4	-0.5	-0.2	-0.2	0.1	-0.1	-0.1	-0.2	-0.1	0.4
1911 ...	0.4	-0.2	-0.4	0.0	0.0	-0.1	0.1	-0.1	-0.3	-0.1	0.1	0.0	0.0	0.3
12 ...	0.3	0.2	0.7	0.1	0.7	-0.1	0.2	-0.2	0.3	-0.2	-0.3	-0.2	-0.1	-0.3
13 ...	-0.3	-0.5	-0.3	-0.8	-1.3	-0.6	-0.5	-0.1	0.4	0.2	0.1	-0.2	-0.6	-1.1
14 ...	-1.0	-1.0	-0.8	-1.0	-1.0	-0.9	-0.7	-0.5	-0.2	-0.2	-0.1	-0.5	-0.8	-0.8
15 ...	0.1	-0.1	0.6	0.4	0.4	0.0	0.0	0.1	-0.4	-0.3	-0.1	0.1	0.1	0.6
1916 ...	0.7	0.4	0.0	0.0	0.1	-0.3	0.1	-0.5	0.2	-0.3	-0.4	-0.3	-0.2	0.0
17 ...	0.8	0.6	0.3	0.4	0.2	-0.3	-0.4	-0.2	0.7	-0.3	-0.1	-0.1	-0.2	0.2
18 ...	-1.7	-1.5	-0.8	0.5	-0.6	0.9	-0.2	-0.2	0.1	-0.2	0.1	-0.2	-0.5	-0.3
19 ...	-0.5	-0.6	-0.2	0.0	-0.1	-0.2	0.2	-0.5	-0.2	-0.4	-0.6	-0.2	0.0	0.3
20 ...	-0.5	0.6	-0.4	0.6	-0.9	-0.4	0.6	-0.4	0.0	-0.1	0.0	-0.1	-0.4	-0.8
1921 ...	-0.4	-0.7	-0.9	-0.7	-0.4	-0.9	-1.4	-0.5	-0.9	-0.2	0.1	-0.4	-0.6	-0.1
22 ...	0.2	-0.2	-0.6	-0.6	0.8	-0.9	-0.6	-0.7	0.3	-0.3	-0.3	-0.5	-0.7	-1.1
23 ...	1.1	0.4	0.1	-0.2	-0.3	-0.3	-0.7	-0.4	0.1	-0.4	-0.4	-0.4	-0.3	-0.4
24 ...	0.8	0.4	0.2	0.4	0.4	-0.2	-0.3	-0.2	0.1	-0.2	0.0	-0.1	-0.1	-0.1
25 ...	-0.2	0.0	-0.2	-0.5	0.0	-0.5	-0.2	-0.2	0.1	0.0	0.0	-0.1	-0.4	-0.2
1926 ...	1.2	0.6	0.5	0.2	-0.2	0.1	0.0	0.2	0.3	0.4	0.4	0.2	0.0	-0.3
27 ...	0.6	0.6	0.8	0.4	0.4	0.3	0.1	0.1	0.7	-0.3	0.0	0.1	0.2	-0.3
28 ...	1.2	1.1	1.4	0.6	-0.1	0.5	0.6	0.2	1.0	0.0	0.0	0.0	0.1	-0.1
29 ...	1.6	1.3	1.2	0.4	-0.2	0.2	0.4	0.2	0.9	0.1	0.1	0.1	0.0	0.2
30 ...	0.8	0.5	0.8	0.2	-0.3	-0.1	0.0	0.0	0.3	0.2	0.0	-0.2	-0.4	-0.7
1931 ...	0.9	0.3	0.8	0.5	0.4	0.1	0.1	-0.1	0.4	-0.1	-0.1	0.2	0.4	-0.4
32 ...	1.0	0.9	0.9	0.8	0.9	0.2	0.4	0.4	0.7	0.3	0.2	0.1	0.5	0.5
33 ...	0.5	0.4	0.9	0.6	0.3	0.8	0.8	0.6	1.1	0.5	0.7	0.7	0.8	0.3
34 ...	0.9	0.6	0.7	0.2	0.2	0.2	0.4	0.4	1.0	0.5	0.3	0.3	0.1	0.4
35 ...	1.3	0.7	0.9	0.2	-0.3	0.3	0.4	0.4	0.9	0.4	0.2	0.4	0.2	-0.2
1936 ...	1.0	0.8	1.4	0.8	0.4	0.7	0.3	0.5	1.2	0.7	0.4	0.7	0.8	0.0
37 ...	0.5	0.3	0.4	0.3	0.7	-0.3	0.2	0.1	0.8	0.4	0.4	0.1	0.0	0.2
38 ...	-0.7	-0.6	0.0	0.0	0.4	0.0	-0.2	0.3	0.7	0.5	0.4	0.3	0.0	-0.1
39 ...	0.4	0.3	1.1	0.5	-1.0	0.7	1.7	0.5	1.1	0.6	0.6	0.4	0.0	-0.4
1945 ...	0.2	-0.2	0.7	0.0	—	0.8	1.2	1.2	2.0	1.3	1.4	1.4	1.1	—
1946 ...	0.5	0.0	0.7	0.5	-0.2	0.7	1.1	1.1	1.7	0.8	0.8	1.0	0.6	0.2
47 ...	0.7	0.7	0.9	0.3	0.5	0.3	0.6	0.7	1.2	0.9	0.7	0.8	0.1	-0.4
48 ...	0.9	-0.2	0.4	0.6	-0.1	0.0	0.6	0.2	1.0	0.5	0.4	0.2	0.4	-0.2
49 ...	0.0	-0.5	0.0	-0.2	-0.7	0.2	0.3	0.4	0.9	0.7	0.8	0.4	0.2	-0.3
50 ...	0.5	0.4	0.3	0.2	-0.2	0.1	0.5	0.4	0.8	0.6	0.6	0.5	-0.1	-0.2
1951 ...	0.4	0.3	0.4	-0.2	0.5	-0.1	0.2	0.3	0.7	0.4	0.1	0.2	-0.2	-0.3
52 ...	0.3	0.3	0.6	0.5	1.4	-0.1	0.2	0.1	0.6	0.1	0.2	0.3	0.2	0.3

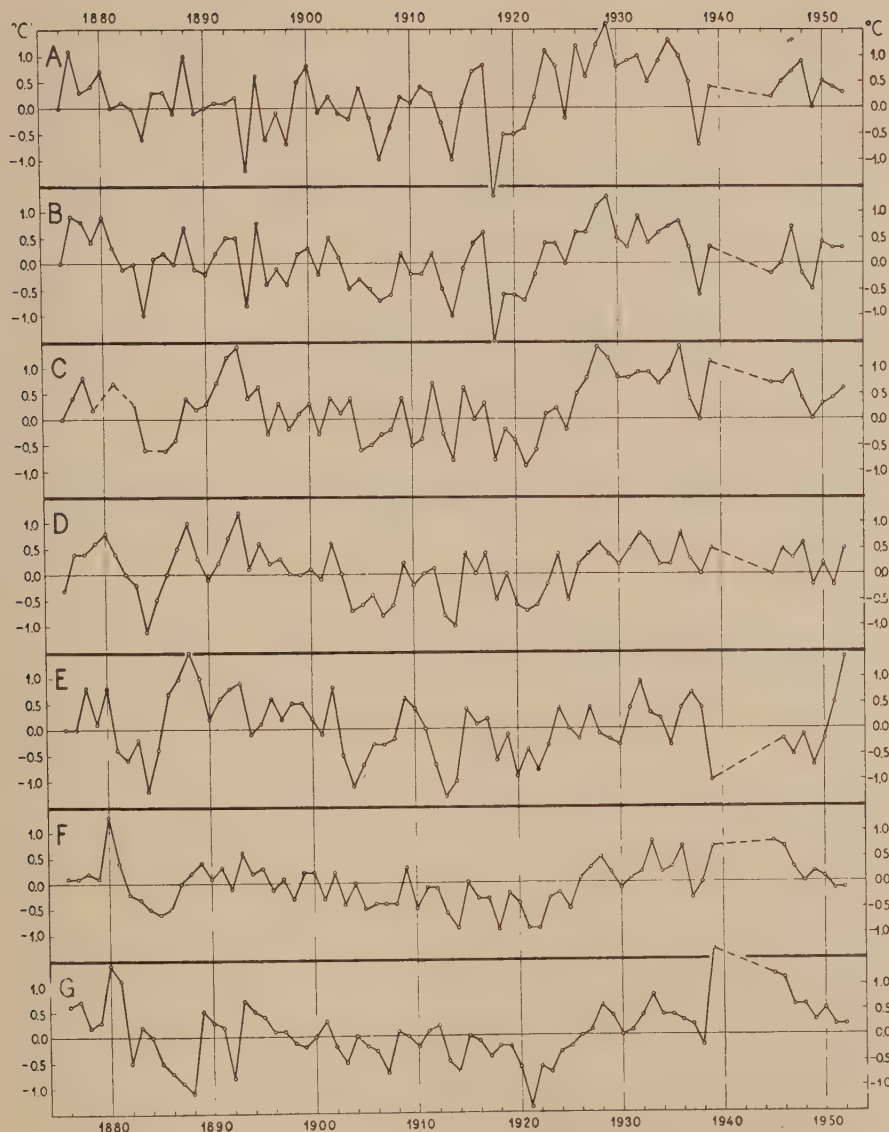


Figure 4 a. Yearly anomalies of surface temperature in the areas A—G (see Fig. 1).

1914—50, together with deviations for 1952 from these means, based on data received from the Danish Meteorological Institute. The mean temperature for 1952 is 0.4°C . lower than the mean temperature for 1951. This accords well with the result found above that the temperature in area J has fallen 0.3°C .

For placing unpublished data at my disposal I am greatly indebted to Messrs. H. THOMSEN and I. SESTOFT, of the Danish Meteorological

Institute, and Dr. M. RODEWALD, of the German Weather Service.

JENS SMED

Variation of the Surface Temperature in the northern North Atlantic during 1876—1952.

In a series of papers in the *Annales Biologiques* monthly anomalies of the surface temperature in the areas indicated in Figure 1 were

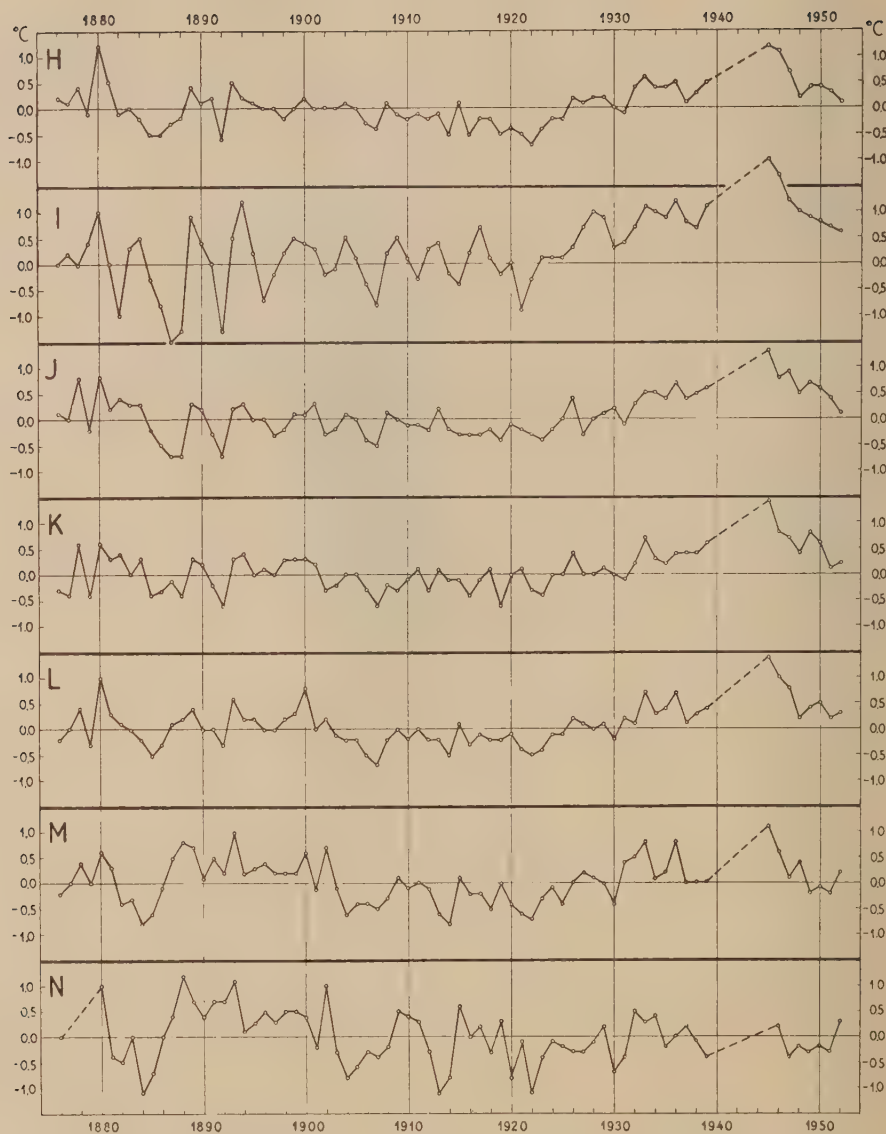


Figure 4 b. Yearly anomalies of surface temperature in the areas H—N (see Fig. 1).

given for the period 1876—1952. The grand monthly means for 1°-squares over the period 1876—1915, published by RYDER, were used as standard values.

These monthly anomalies have now been averaged for each year of the period considered, and at the instigation of the Chairman of the North-Western Area Sub-Committee, Dr. Å. VEDEL TÅNING, the results are presented in this paper.

The yearly anomalies are given in Table 3

and have, furthermore, been plotted in Figure 4. The preponderance of positive anomalies since the middle of the twenties is conspicuous for all areas except E and N, i.e., the two areas south of 55° N.

The main tendency of the temperature variation becomes still more conspicuous in Figure 5 where the values of Table 3 have been smoothed out by computing 5-year overlapping means.

JENS SMED

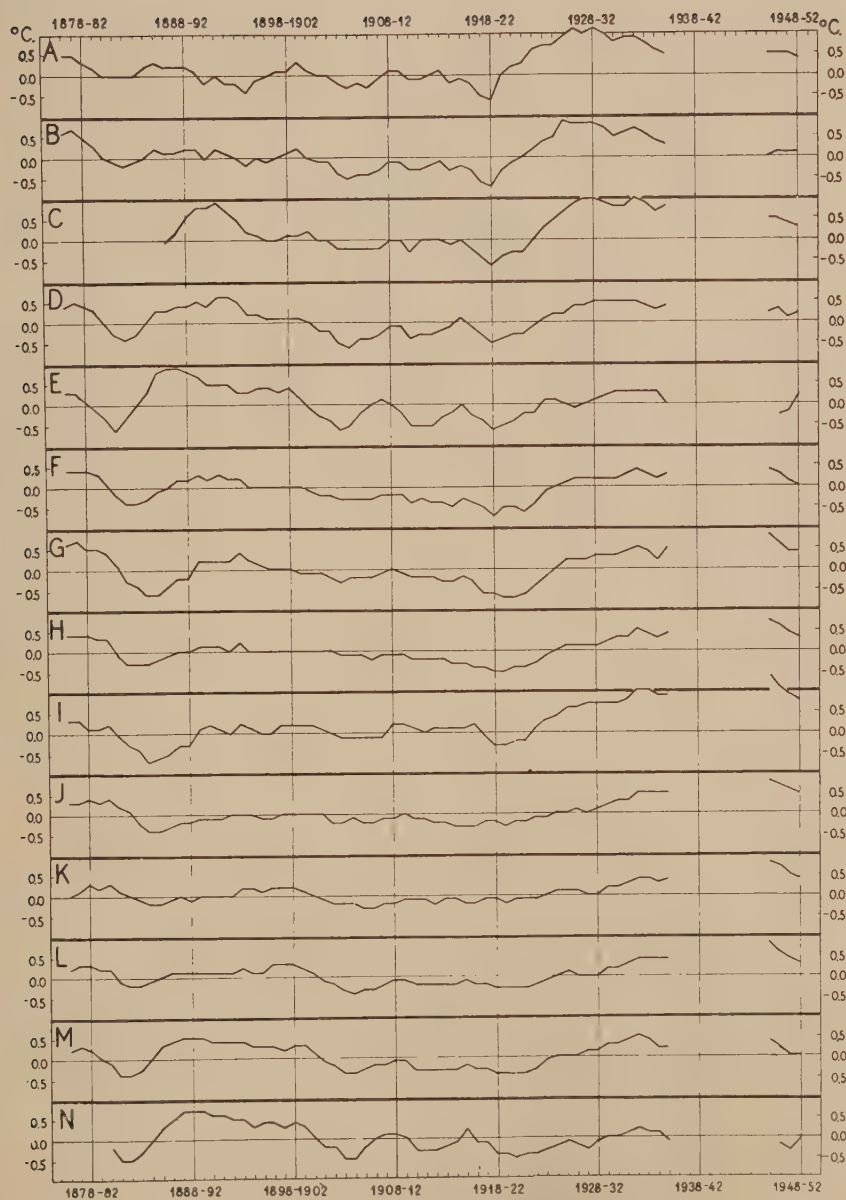


Figure 5. Overlapping 5-year means of surface temperature anomalies in the areas A—N (see Fig. 1).



Figure 6. Temperature and salinity, March.

Hydrographic Conditions in the Southern Part of the Norwegian Sea, 1952.

During 1952 the Danish investigations were concentrated in the herring area north and north-east of the Faroes. In connexion with the herring investigations, hydrographic observations were carried out, in March, July, and November, from the fisheries inspection ship "Thetis" under the command of Commander JØRGEN LØLLE, in May from the R/V "Jens Væver", and in June from R/V "Dana" under direction of E. BERTELSEN.

The distribution of temperature and salinity at different depths is given in Figures 6—10.

The boundary between the warm Atlantic water and the tongue of the cold water from the East Icelandic Current was, as usual, very sharp and followed a very complicated course. The cold water seems to have had its greatest extension towards the east in March or maybe earlier and its greatest extension towards the south in May, where a tongue of the cold water was found close in north-east of the Faroes.

The most extensive investigations were made from "Dana" in June (Fig. 8). Comparison with earlier years' observations shows that the location of the boundary between the cold and the Atlantic water is nearly the same as in 1951. Some of the details in its complicated course

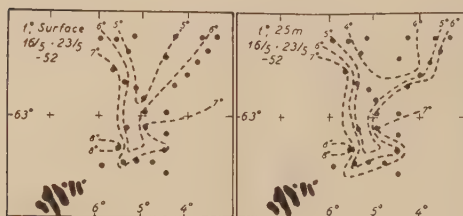


Figure 7. Temperature, May.

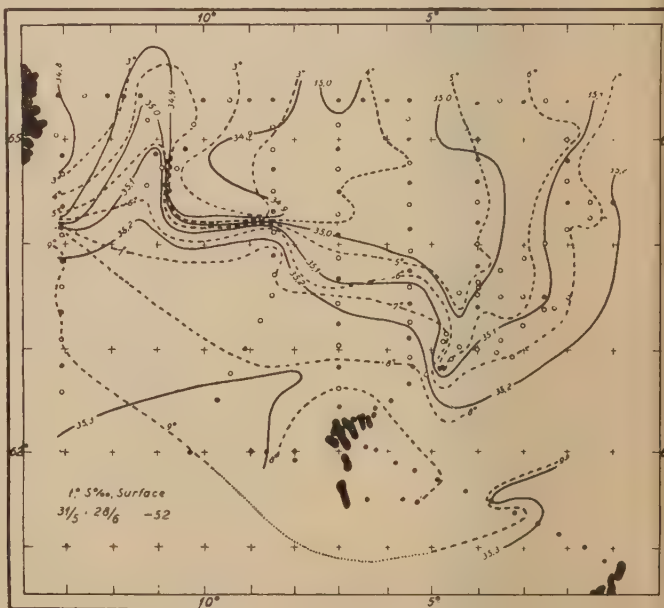
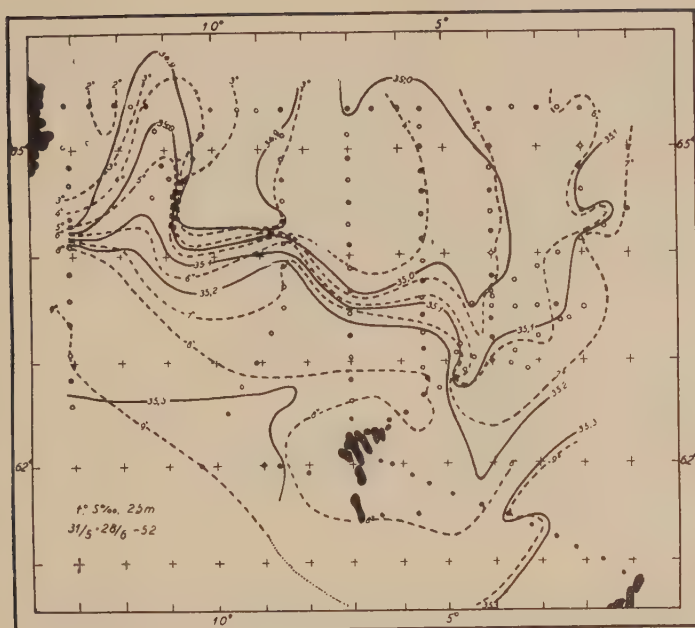


Figure 8 a. Temperature and salinity, June.
Surface, →



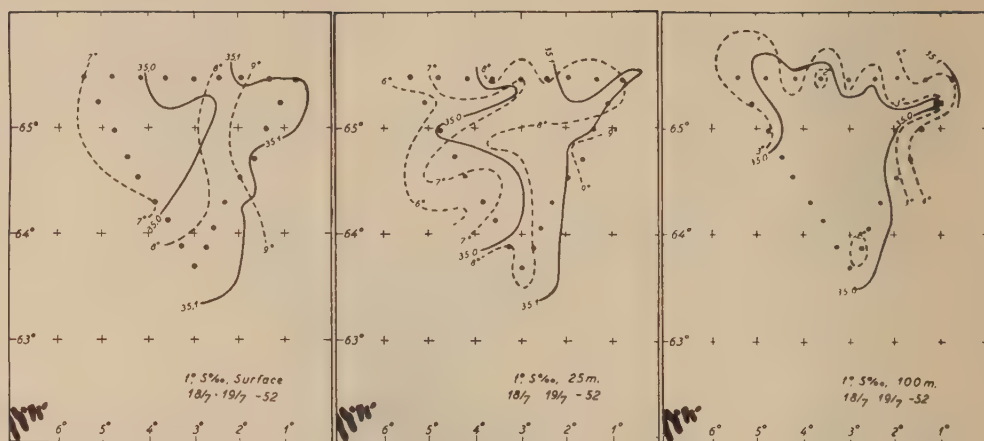


Figure 9. Temperature and salinity, July.

seem to be stationary, thus at about Long. 11° W. a tongue of Atlantic water extends northwards dividing the East Icelandic Current into two parts. This was also found during the investigations in 1950. In the eastern part of the area a continuation of the cold water is found as a narrow tongue going southward to the central part of the Faroe-Shetland Chan-

nel. This feature is found more or less pronounced every year.

The hydrographic conditions are further illustrated by the Faroe-Shetland section, Figure 11, and the section, Figure 12, from the Faroes northwards along $5^{\circ}30'$ W. In both sections the conditions seem to be about normal.

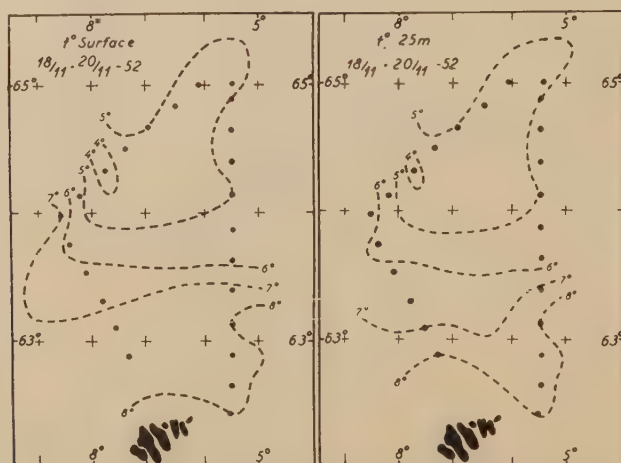


Figure 10. Temperature and salinity, November.

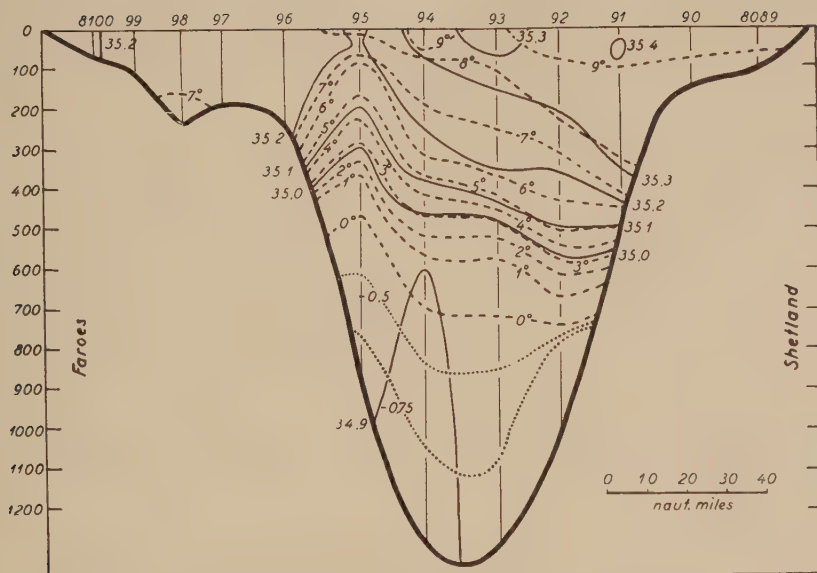


Figure 11. Faroe-Shetland section, 31. May to 1. June.

On the cruises herring shoals were located by means of echo-sounders and, from the "Thetis", by means of "sonar". In March the herrings had not yet arrived in the area investigated. In May the herrings were found mainly in the boundary of the cold tongue and in greatest concentration along the 6° isotherm in 25 metres. In June the herring shoals were

found most frequently in the eastern boundary between the cold and the warm water and mainly concentrated at temperatures between 6° and 7° in 25 metres. Herring shoals were, however, also found in the western limit of the warm tongue situated at 11° W. Here the herring were found at temperatures down to 3°.

FREDE HERMANN

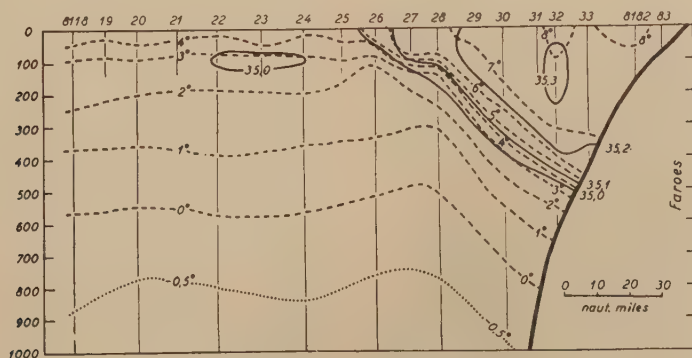


Figure 12. Section along 5°30'W.

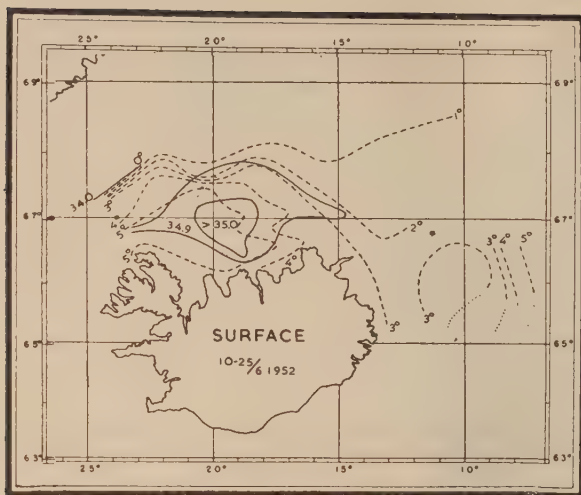


Figure 13.

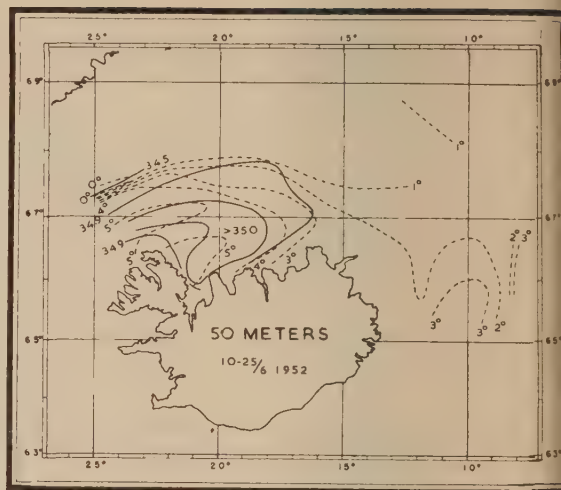


Figure 14.

Hydrographic Conditions in the Iceland Sea in June 1952.

From 10. June to 25. June hydrography and plankton investigations were carried out in the waters north and north-east of Iceland.

Weather conditions in June were most unfavourable for work at sea on account of the persisting north and north-easterly winds. On the north coast of Iceland, the month could be

considered the coldest June for a long time. It is of interest to note, however, that the ice limit off Kögur on the north-west coast was at this time found to be about 80 nautical miles offshore and thus a trifle farther off than shown on maps giving the mean position of the ice limit for this month. The abnormally cold spring at north Iceland was therefore not caused by an unusual proximity of the drift ice. The lasting north-easterly winds have probably even driven the ice away from Iceland which agrees with the conclusions arrived at in a report issued by the Hydrographic Department of the British Admiralty in 1946¹⁾, where it was considered that the main reason for the encroachment of ice towards Iceland is the establishment of SW.-winds in the Denmark Strait.

The surface temperature is shown on Figure 13. Compared with the 1901—30 mean for June in the area south of 67° N., the surface temperature off the north-west coast has been about 0.5° C. below normal, about normal in the middle area, but 1—2° C. below normal in the eastern area. At the same time in 1947 the temperature was 2° C. higher, in late June 1951 and around the middle of May 1950 it was very similar to what it was in June 1952. We may therefore conclude that the surface temperature in June 1952 was unusually low. The highest surface salinity was observed in the middle part of the coastal area, where it exceeded 35.00/00.

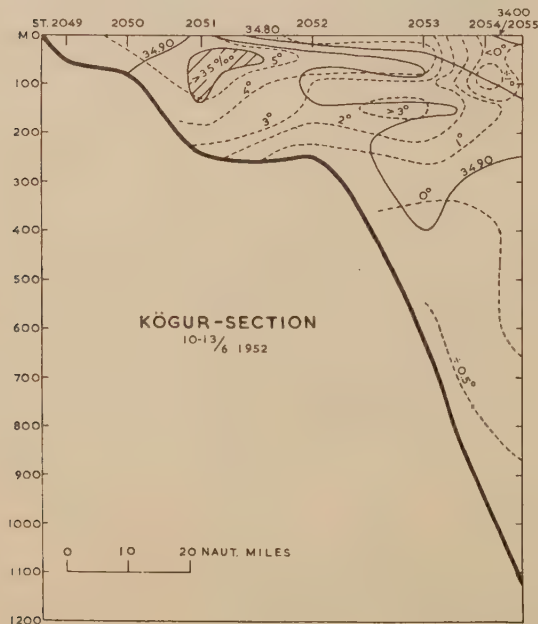


Figure 15.

¹⁾ H. D. 421, Hyd. Dept., Admiralty.

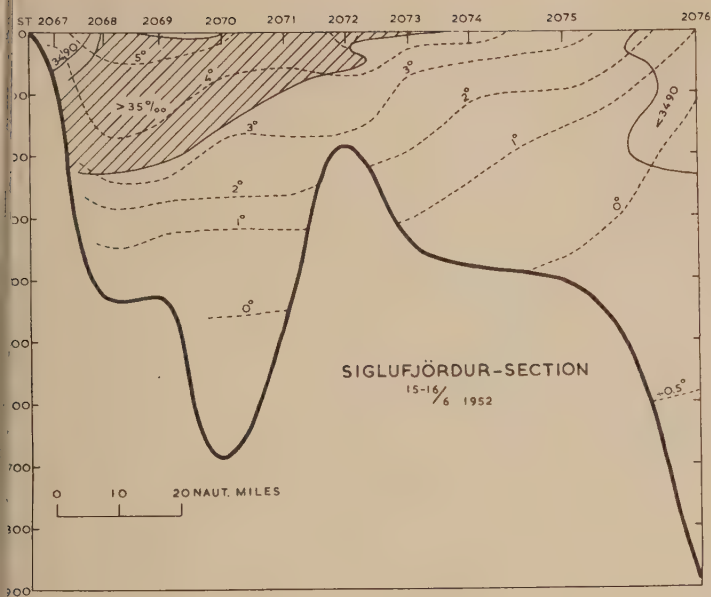


Figure 16.

At the 50 m. level (Fig. 14) the temperature has been relatively higher than at the surface. The course of the isohalines indicates that the Atlantic influx in the north Icelandic coastal area had extended slightly beyond Siglufjörður. East of Langanes, near 10°W., the isotherms are seen to make, as usual, a characteristic bend caused by a tongue of warmer water from the south.

In the Kögur section (Fig. 15) the temperature and the salinity are lower than has been observed before in this section in June, and the extension of Atlantic water is very limited. In the mixing area at the edge of the shelf the course of the isolines

is very irregular and farther north the typical Polar water is encountered in the surface layers.

In the Siglufjörður section (Fig. 16) the conditions resemble closely those found at the end of May 1950. Thus the 0°, 1°, 2°, and 3° isotherms are found at almost exactly the same depth as they were found in May 1950. As usual at this time of the year the Atlantic water occupies the surface layers but does not extend much below 200 metres.

Figures 17 and 18 illustrate the hydrographic conditions in the sections from Langanes towards Jan Mayen and east of Langanes. Cold, arctic water is seen to fill both of these sections. Outside the coastal area the temperature decreases from 1—2° at the surface to less than 0° at 100 metres depth in the Jan Mayen section and from 2—3° to less than 1° in the Langanes section. East of 8°W. the temperature increases sharply indicating the eastern limit of the East Icelandic Current.

UNNSTEINN STEFÁNSSON

Section from the Faroe Islands to East Greenland.

Figure 19 shows the section worked by R/V "Dana" from 20. June to 4. July. Owing to strong gales the westernmost part of the section could not be completed. The main features are

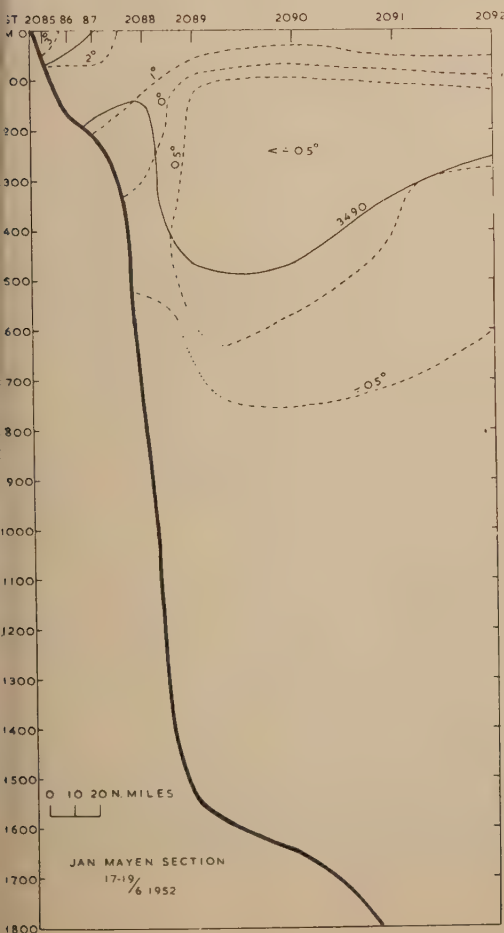


Figure 17.

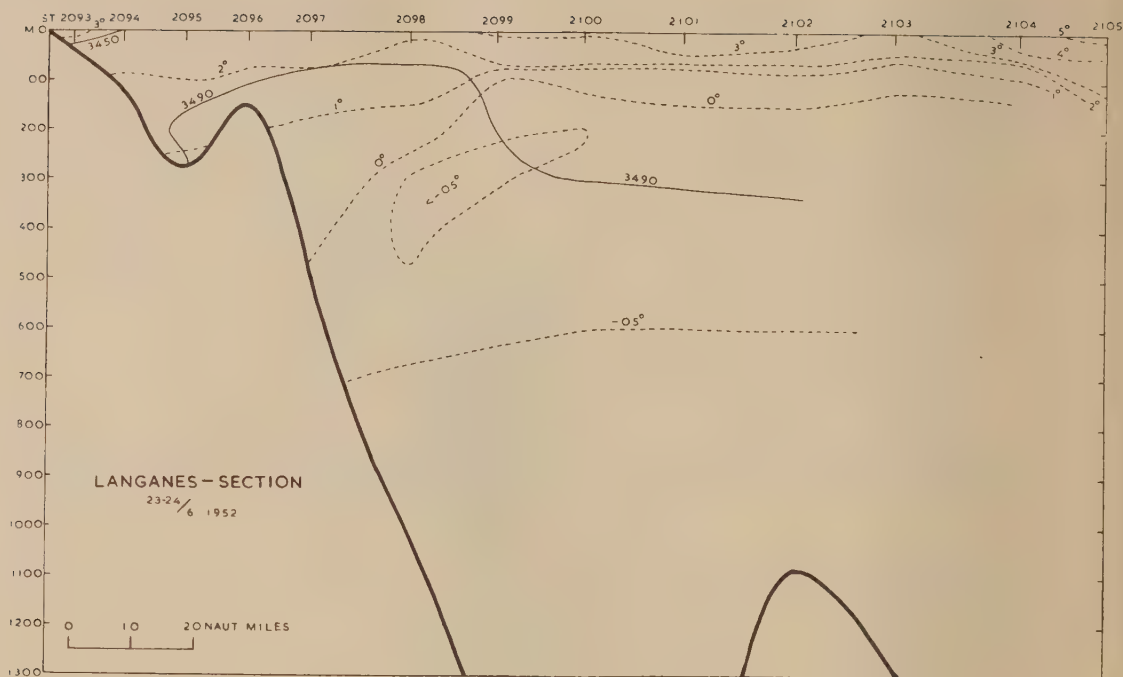


Figure 18.

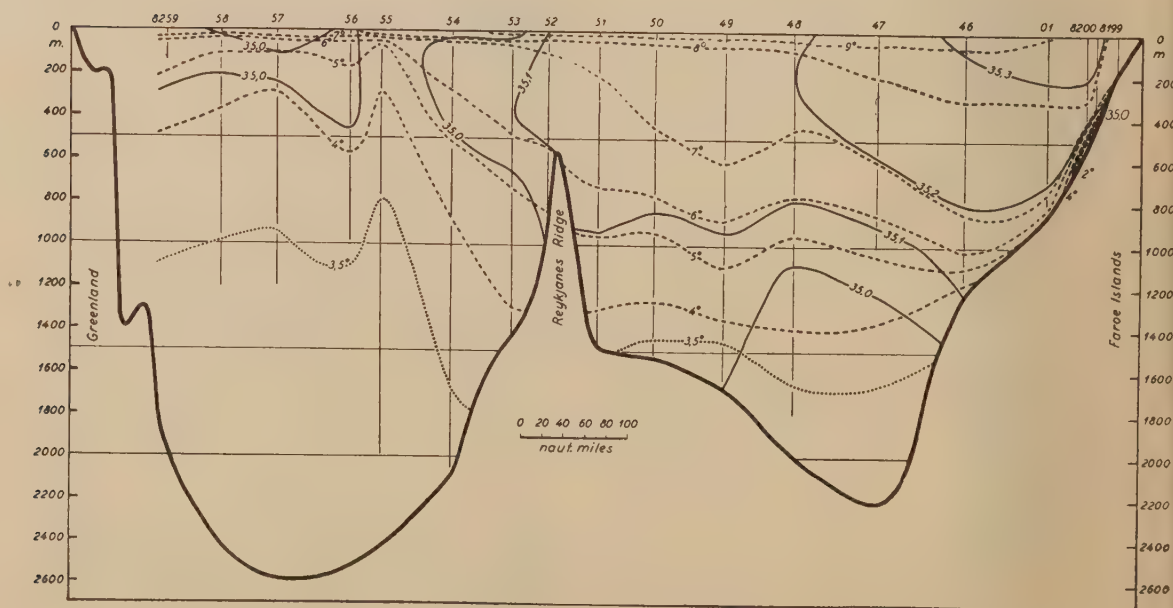


Figure 19. Section from the Faroe Islands to Greenland, 20. June to 4. July 1952.

the same as found in 1950 and '51. In Ann. Biol. 1951, it was shown how the temperature in the eastern part of the section has decreased since 1948 in the upper 1000 metres. A comparison between the conditions in 1951 and 1952 shows that the temperatures in 1952 were a little higher in the easternmost part of the section.

West of Reykjanes Ridge we find the north-going branch of the Irminger Current between stations 8254 and 8252. From station 8256 and westwards we find the southgoing part of this current with salinities exceeding 35‰ . The two parts of the current are separated by a tongue of subarctic water extending from the south.

The deep water in the basin west of Reykjanes Ridge seems to be colder than in 1950. In 1952 the 3.50 isotherm in the central part of the basin was found at about 1000 metres, while, in 1950, it was found at about 1700 metres.

FREDE HERMANN

Hydrographic Conditions off the West Coast of Greenland, 1952.

During July 1952 the hydrographic stations shown in Figure 20 were worked by the Danish R/V "Dana".

Figure 20 gives the distribution of temperatures at 50 m. in July. The water temperatures were, in this year, exceptionally low; the influence of the Arctic component of the West-Greenland Current was very pronounced, and the Atlantic component was weak and cold. In Figure 20 the Atlantic current appears as a tongue of warm water off south-west Greenland. The cold part of the current keeps close to the coast near the southernmost part of Greenland, but off Godthaab the main part of it turns westwards and appears as a belt of cold water off Fylla Bank.

North of Fylla Bank the influence of the Polar Current was less pronounced, and here the temperature conditions were nearer normal. The westernmost stations in the northerly sections are situated in the cold water of the Canadian Polar Current.

The sections I to VIII, the locations of which are given in Fig. 21, show the vertical distribution of temperature and salinity. Especially in section III, over Fylla Bank, very low temperatures were found. Off the western slope of the bank, Arctic water was met having tempe-

ratures below zero at a depth of 100 metres. The warm undercurrent was situated very deep in sections III and IV, and its maximum temperature did not reach 4° , which is rather unusual.

Phosphate determinations were carried out down to 100 m. on all the sections. On most stations the concentration of phosphate in the surface layers was low; in sections I and II, in the mixing area between the Arctic and the Atlantic currents, a phosphate content of $0.7\text{ }\mu\text{g. at./l.}$ was, however, met at the surface. Also, in section V, at the limit of the Arctic Canadian Current a phosphate content of $0.6\text{ }\mu\text{g. at./l.}$ was found.

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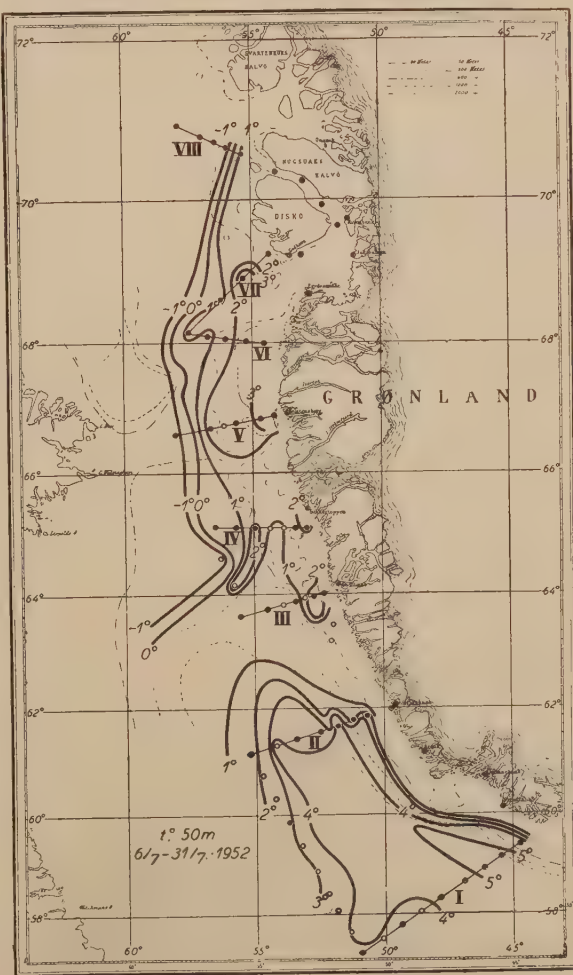
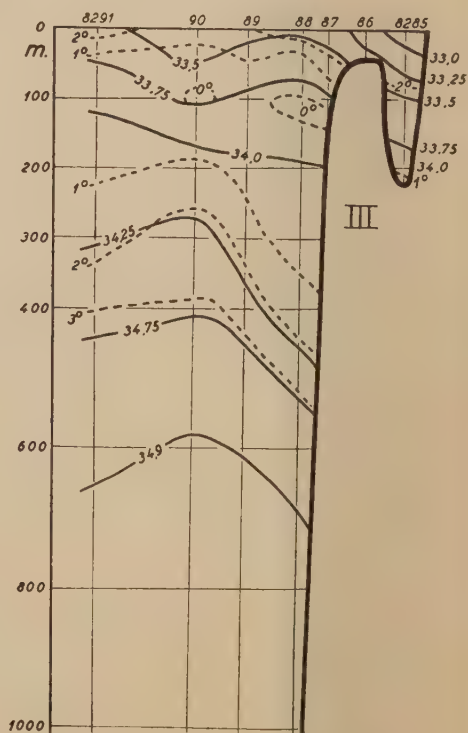
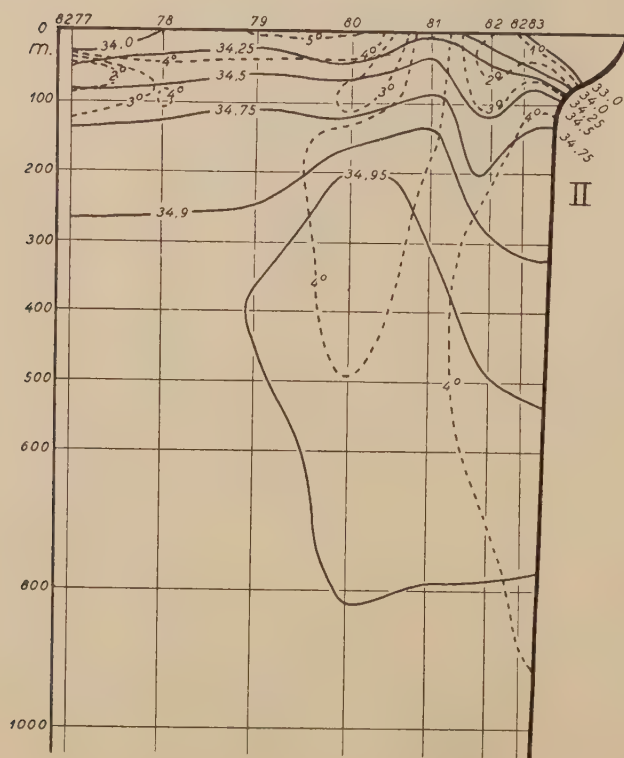
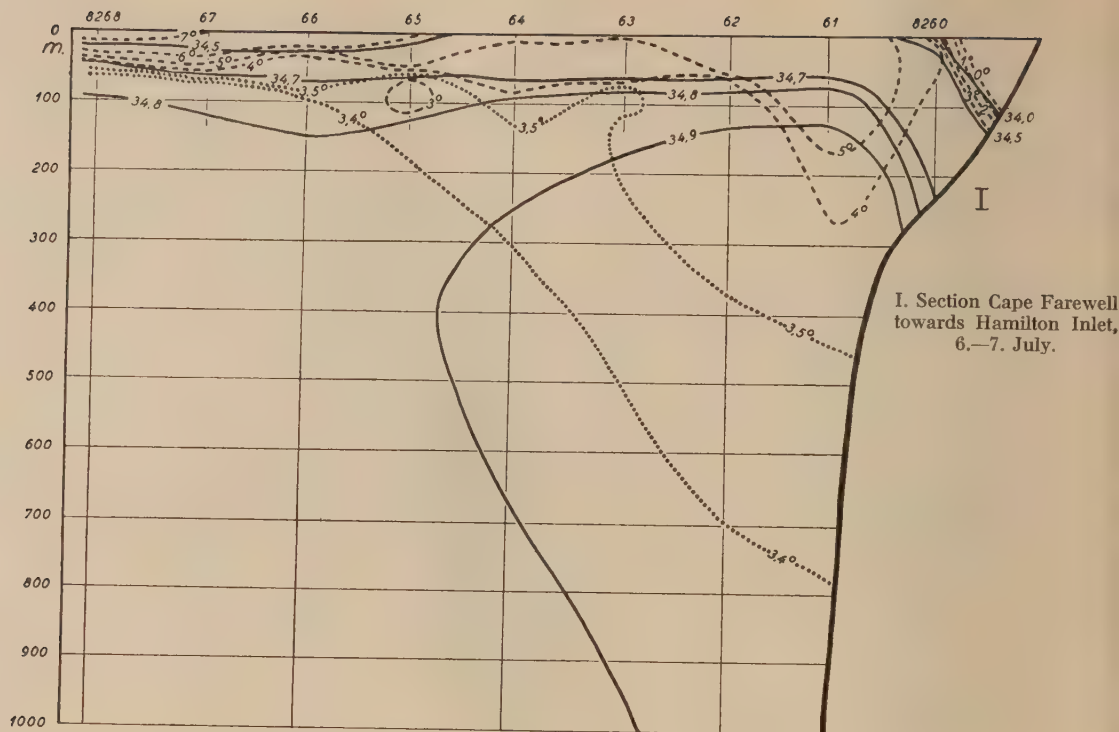


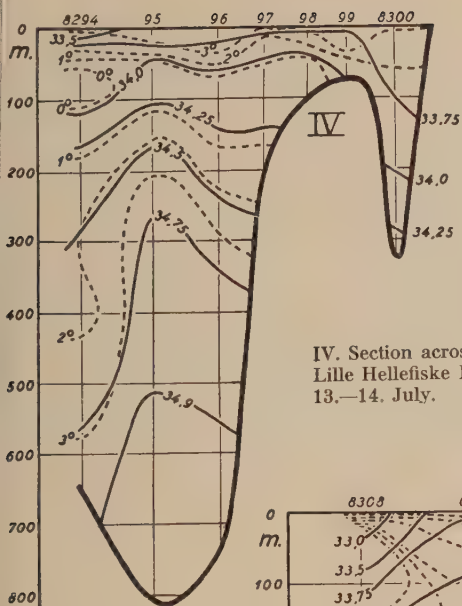
Figure 20. Location of sections and distribution of temperature in 50 m. Open circles indicate bathythermograph stations, full circles regular hydrographic stations.



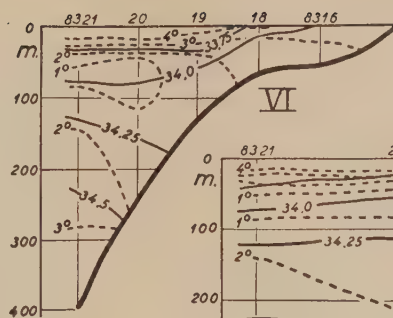
II. Frederikshaab section, 9.—10. July.

III. Section across Fylla Bank, 12.—13. July.

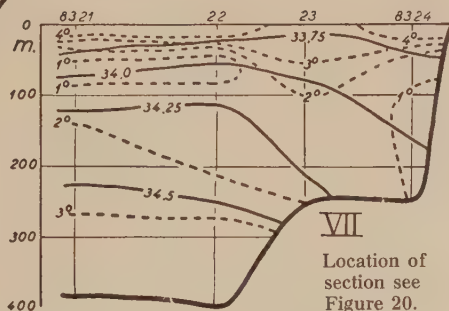
Figure 21. I to VIII vertical distribution of temperature and salinity.



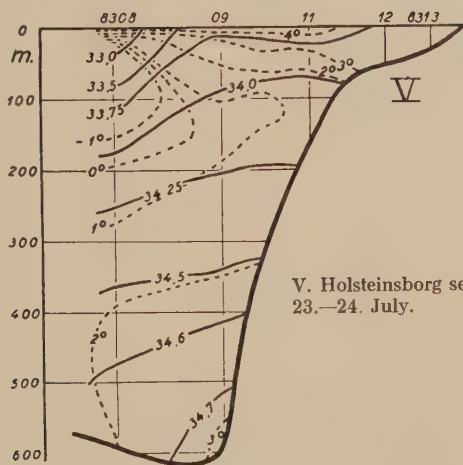
IV. Section across
Lille Hellefiske Bank,
13.-14. July.



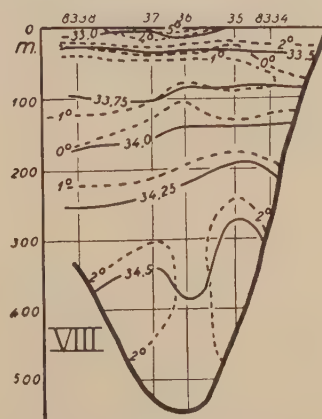
VI. Egedesminde section,
26. July.



VII
Location of
section see
Figure 20.



V. Holsteinsborg section,
23.-24. July.



VIII. Hareå section, 31. July.

Influence of Temperature on Strength of Cod Year-Classes.

As mentioned in Ann. Biol. 1950, a coincidence has been found between production of rich cod year-classes and warm temperature conditions off West Greenland. The correlation is shown in Figure 22 where the strength of the cod year-classes is plotted against the temperature over Fylla Bank in June, for all the years in which temperature observations are available. The yield of the year-classes in the Greenlanders' fishery up to 1946 (after PAUL

HANSEN¹⁾) is used as a comparative measure for the strength of year-classes.

This is, of course, not strictly a quantitative measure, the two main errors are that the year-classes after 1934 were not yet outfished and that the fishing intensity has increased during recent years. These errors are working against each other and their combined effect is probably small. The temperature used is measured at 40 m. and represents, fairly well, the temperature in the water column 0-50 m. where the cod larvae are mainly found.

¹⁾ Hansen, P. M. "Studies on the Biology of the Cod in Greenland Waters". Rapp. et Proc.-Verb., 123, p. 71.

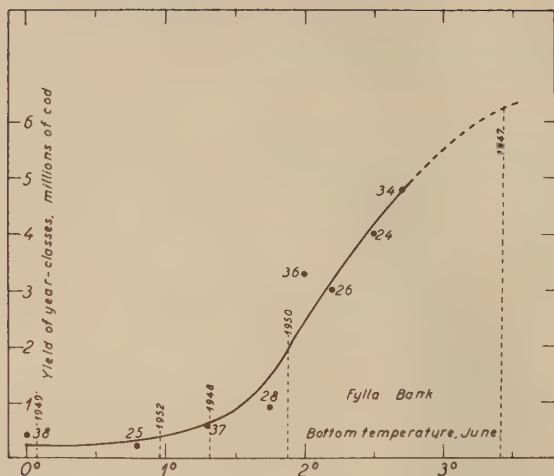


Figure 22. Yield of cod year-classes as function of temperature over Fylla Bank in June.

It is seen in the figure that the warm years 1934, '24, '26, and '36 have all produced very rich year-classes, while the cold years have only produced poor year-classes. A smooth curve is drawn through the points, and the temperatures from the recent years are marked by broken lines. The points of intersection of these lines with the curve should make possible a prediction of the magnitude of the corresponding year-classes. The very warm year, 1947, should produce a very good year-class and the 1950 year-class may also be of some importance, from the years 1948, '49, and '52 only unimportant year-classes should be expected. Fishing experiments off West Greenland in 1952 confirmed that the 1947 year-class is one of the greatest ever seen in Greenlandic waters.

FREDE HERMANN

Plankton.

Investigations from Scottish Research Vessels.

Surveys of the Faroe Channel and Faroe area were made by the Scottish research vessels in February, March, May, June, July, and November, and along the south coast of Iceland in September. These surveys included plankton sampling by means of vertical, oblique and horizontal nets.

The spring outburst of phytoplankton in the Faroe plateau was noted in March when the dominant species were *Chaetoceros atlanticus*, *Ch. decipiens* and *Coscinodiscus concinnus* with some *Halosphaera*. The summer oceanic phytoplankton appeared to be rather scattered in local concentrations, one particularly dense patch about 60 miles across was located in July to the north of Faroe Bank, the dominant species being *Rhizosolenia styliiformis*, *Thalassiothrix longissima* and *Chaetoceros sociale*.

The zooplankton from the Butt of Lewis to Faroe Bank showed the usual divisions as sampling crossed the lanes of differing communities: i.e., on the continental shelf; in the

deep area between the shelf and the Wyville Thomson Ridge; between the Ridge and Faroe Bank; and over Faroe Bank. These divisions can be associated with corresponding communities found in the line of stations between Faroe and Shetland.

The plankton on the continental shelf is typified by a community of *Sagitta elegans* with some *S. serratodentata*, *Calanus finmarchicus* and *C. helgolandicus* etc., and is poor in the oceanic forms so characteristic of the adjoining section in and over the deep water. This coastal plankton is contiguous with that of the coastal belt off the west Scottish coast and may be traced throughout the whole year along the north coast of Scotland to the Orkneys and Fair Isle where there was little evidence of the presence of oceanic plankton until late summer (see North Sea report).

In the upper 250 metres but over the deep water, between the edge of the shelf and the Wyville Thomson Ridge, was flowing a constant stream of oceanic fauna containing species such as *Agalma elegans*, *Sagitta serratodentata*, *Rhincalanus*, *Eucalanus* etc. which had

their origin in the open north-west Atlantic. *Calanus finmarchicus* was not abundant and *C. helgolandicus* appeared to be absent. A quite different fauna was found in the mid-water layers, approximately 750—250 m., and this contained *Sagitta lyra*, *Clio pyramidata*, the polychaetes *Vanadis formosa* and *Callizona angelina*, a series of siphonophores including *Hippopodius*, *Nectopyramis*, *Vogtia*, *Lensia*, *Chephotyphes* etc. and many other oceanic species. This is the same community as occurred at a similar depth off the Scottish coast at 57°N. and off the north-west of Ireland at 55°33'N., and it was also present to the north-west of Shetland, though the less tolerant species were less numerous in the more northerly positions. This community would appear to be recruited from the neighbourhood of the Azores or "Lusitanian area" and followed the edge of the continental shelf northwards.

Below this mid-water fauna was found boreal plankton, *Calanus hyperboreus*, *Metridia longa*, *Sagitta maxima*, *Eukrohnia hamata* etc.

North of the Wyville Thomson Ridge the surface and bottom faunas were similar to those found south of the Ridge but the mid-water belt with the rich Lusitanian fauna was absent. This community can be linked with that found on the north-western end of the Faroe-Shetland line but with the difference that the surface

oceanic species were rather less abundant and the boreal forms more abundant in the north, and with the addition of very abundant *Calanus finmarchicus*. An interesting record from 62°24'N. 1°00'W. in May was *Eusirus holmi* an amphipod normally found much further north and in the Barents Sea.

As the plankton programme in the Faroe Channel is directly connected with the Scottish work in the North Sea area the results are examined further in the report to that committee.

The plankton of the Faroe area was studied especially for fish eggs and larval fish and is separately reported by Mr. SAVILLE, see below. *Aurelia aurita* as usual became abundant in the autumn being particularly so in local areas in November. Very little plankton work was done off the Icelandic coast but a series of ten stations from Storksnaes to Faxe Bay was examined in September. These showed a general scarcity of crustacean plankton, including *Calanus*, except off Ingolfshöfði (63°38'N. 17°11'W.) and even there the *Calanus* seemed particularly lacking in oil content. There was a little evidence of oceanic plankton at 63°47'N. 22°12'W. in Faxe Bay. Plankton was scarce on the whole, the dominant species being *Bougainvillia britannica* and *Phialidium hemisphaericum*.

J. H. FRASER.

THE FISH

Eggs and Larvae.

Faroes.

Scottish Haddock Investigations.

In an intensive survey of Faroese waters, similar to those of 1950 and 1951, the area was sampled during the following periods:— 11.—18. February, 14.—21. March, 6.—17. April and 9.—21. June.

In 1952 the haddock spawning season followed a similar course to that described for 1951. The February cruise located no haddock eggs, and in March only eggs in early stages of development were taken. Spawning accordingly must have commenced about the second week of March, and judging from the size distribution of the larvae taken in June, con-

tinued till mid-May. The highest spawning intensity was achieved during the period of the April cruise, being ten times the value attained during the March cruise, and a hundred times that estimated for May. Total egg production for the 1952 spawning season at Faroe is estimated at 6×10^{12} eggs, about midway between the 1950 and 1951 figures.

On the March cruise the spawning area was extremely restricted; large numbers of eggs being found only over Nolsø Bank. By April spawning was much more extensive, and high concentrations of eggs occurred on the edge of the shelf to the north-west of the islands, over the Nolsø-Fuglø Bank region, to the west of Kolter, and off the west side of Syderø extending southwards to the southernmost tip of the plateau. The subsequent distribution of the products of these spawnings was compatible with an anti-cyclonic current system around the islands; except that those derived from the March spawning on Nolsø Bank, had by April moved off to the north-east over Fuglø Bank.

Due to the fact that the area could only be sampled twice whilst larvae were present, satisfactory growth curves cannot be drawn from the 1952 data. The increases in the modal sizes between these two cruises however were compatible with the coefficient of growth calculated from previous years' work in the area. The cruises were also too few to enable mortality estimates for different developmental stages to be given. An estimate of mean daily mortality, between newly spawned eggs and larvae of 30 mm. gave a figure of five per cent. per day. This figure is substantially the same as that for 1951, and with the increased egg production of the 1952 season, augurs well for the prospects of that brood year at Faroe.

ALAN SAVILLE.

Occurrence of pelagic 0-group Cod, Haddock, Whiting and Saithe, Summer 1952.

Fishing with stramin nets for pelagic fish larvae in the Faroe area was carried out by the "Dana" in June, mainly between the 12th and 15th. Samples were collected on 16 stations (Fig. 23 and Table 4).

Compared with similar investigations in this area at the same time in previous years, the average lengths of the cod and haddock larvae were normal but the numbers caught per hour (averaging 23 cod and 109 haddock) were very

Table 4. Larval Cod, Haddock, Whiting and Saithe.

Total catch on 16 stations¹⁾ over depths between 50 and 200 m. June 1952.

Length (mm.)	Cod	Haddock	Whiting	Saithe
< 5.....	1	11	4	—
5—9.....	78	594	99	5
10—14.....	133	594	13	5
15—19.....	94	222	1	2
20—24.....	29	54	1	7
25—29.....	4	12	—	5
30—34.....	1	4	—	—
35—39.....	—	1	—	—
Total number.....	340	1581 ²⁾	118	24
Number per hour....	23	109	8	1.7
Average length, mm...	13.7	11.7	8.0	18.4

¹⁾ On most stations two oblique hauls of 3×10 minutes each were made with 2-m. stramin nets (100—50—25 and 200—150—125 m. of wire out). In a few cases only the haul with 100—50—25 m. wire out was made.

²⁾ Including 89 specimens not measured.

low. (In other post-war years the average numbers per hour were 50 to 900 cod and 350 to 700 haddock).

Although the investigations were carried out under very unfavourable weather conditions the results indicate that the cod and haddock broods of 1952 are poor.

E. BERTELSEN.

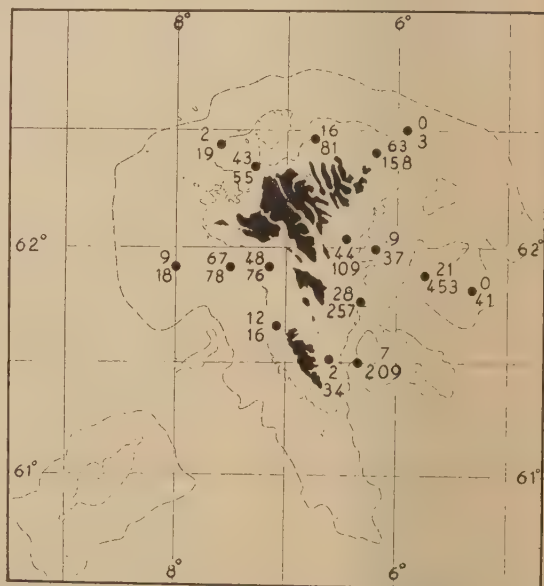


Figure 23. Number of larval stages of cod (above) and haddock (below) per hour's haul with 2-m. stramin net. June 1952.

haddock.

Survey of the Faroe population.

Table 5. Age Composition of Haddock
caught by F. R. S. "Scotia" at Faroe —1952.

(Excluding Faroe Bank).

Numbers per 10 hours' fishing.

Year-class	Feb.	March	April	May	June	July	Nov.
1952	—	—	—	—	0.4	—	488.1
1951	276.7	93.3	397.5	20.0	1350.4	4190.0	300.0
1950	542.5	72.5	915.0	—	255.8	1914.2	81.9
1949	350.0	110.0	277.5	50.0	97.7	143.3	19.4
1948	45.0	51.7	32.5	10.0	28.1	31.7	6.9
1947	1.7	6.7	2.5	—	2.7	5.0	0.6
1946	—	—	—	—	—	—	—
& over	2.5	2.5	12.5	20.0	3.5	21.7	3.1
No. hours	12	12	4	1	26	12	16

Age composition.

The age composition of haddock sampled by "Scotia", and from commercial trawlers on the Aberdeen fish market is shown in Tables 5 and 6 respectively. The size composition of the commercial landings is shown in Table 6 B. By

Table 6. Aberdeen Trawlers' Market Samples - Faroe Haddock - 1952.

A. Number landed/10 hrs. Fishing.

Year-Class	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1951.....	—	—	—	—	—	—	—	—	11.3	14.2	85.2	83.1
1950.....	152.5	38.3	3.2	35.6	233.2	202.0	769.6	659.6	654.8	795.7	591.4	532.8
1949.....	667.6	139.5	173.0	366.3	216.4	210.7	348.1	278.7	369.6	526.0	280.4	217.0
1948.....	229.2	165.1	330.0	442.8	295.0	100.8	146.0	113.0	125.9	129.0	77.6	59.1
1947.....	11.3	19.2	60.1	45.9	23.3	18.8	15.3	20.9	9.9	14.9	7.0	6.3
1946.....	3.9	3.0	18.6	4.6	9.2	3.0	4.6	1.8	2.2	0	2.2	0.9
1945.....	9.3	8.4	24.0	14.8	25.6	16.4	25.0	24.9	13.1	10.7	8.7	5.1
1944.....	14.9	16.7	36.5	23.0	18.1	17.3	30.0	30.5	23.3	6.4	6.7	8.4
1943.....	4.3	8.8	23.1	7.2	6.5	6.0	10.4	8.3	8.1	8.5	4.4	2.5
1942.....	—	4.6	4.1	2.8	0.5	0.4	1.4	1.8	0.2	—	—	1.1
1941+....	0.2	5.2	0.8	6.6	1.0	0.4	—	0.8	0.2	—	—	—

B. Mean Length of each Age-Group sampled.

Year-Class	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1951.....	—	—	—	—	—	—	—	—	30.0	31.5	30.9	31.7
1950.....	31.3	31.4	32.8	32.3	33.0	33.7	33.6	35.1	35.7	35.6	38.4	39.8
1949.....	37.9	39.1	40.1	39.2	41.5	41.3	42.3	43.3	44.2	43.1	46.6	47.4
1948.....	47.4	49.1	48.3	46.7	48.0	49.4	48.9	50.8	51.4	47.8	53.4	52.9
1947.....	54.4	53.2	52.5	52.8	55.6	55.2	56.4	56.8	57.5	57.9	56.7	56.4
1946.....	55.0	56.5	54.5	54.8	57.0	59.8	60.4	60.9	61.9	—	59.2	59.7
1945.....	59.8	55.6	58.5	60.5	59.7	60.8	60.7	63.0	63.5	63.0	62.1	62.0
1944.....	63.7	63.0	63.3	63.0	64.3	64.3	64.0	64.4	65.5	65.3	67.3	64.8
1943.....	66.5	64.9	66.2	69.1	67.9	66.6	66.3	67.2	66.5	67.3	68.1	68.9
1942.....	—	68.9	71.3	70.3	73.0	74.0	67.0	69.2	71.0	—	—	71.8
1941+....	64.0	—	76.7	76.4	80.0	65.0	—	74.0	66.0	—	—	—

C. Estimated Weights*) landed/10 hrs. Fishing in (ewts.).

Year-Class	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1951.....	—	—	—	—	—	—	—	—	0.05	0.07	0.42	0.43
1950.....	0.75	0.18	0.01	0.18	1.31	1.23	4.77	4.76	4.96	6.03	5.69	5.82
1949.....	6.01	1.30	1.71	3.45	2.50	2.49	4.43	3.85	5.41	7.35	4.95	3.99
1948.....	4.90	3.20	5.61	7.01	5.17	2.01	2.85	2.56	2.95	2.41	2.09	1.55
1947.....	0.32	0.48	1.33	1.05	0.65	0.53	0.47	0.67	0.03	0.50	0.22	0.20
1946.....	0.11	0.10	0.45	0.11	0.27	0.11	0.18	0.07	0.09	0.0	0.08	0.03
1945.....	0.35	0.24	0.70	0.52	0.89	0.62	0.98	1.06	0.58	0.45	0.36	0.22
1944.....	0.68	0.68	1.44	0.95	0.77	0.79	1.38	1.41	1.11	0.30	0.39	0.37
1943.....	0.23	0.37	1.02	0.43	0.31	0.29	0.51	0.43	0.40	0.44	0.27	0.14
1942.....	—	0.23	0.20	0.16	0.03	0.03	0.07	0.10	0.01	—	—	0.07
1941+....	0.01	0.15	0.04	0.49	0.06	0.02	—	0.05	0.01	—	—	—
Total.....	12.55	6.91	12.51	14.37	11.97	8.13	15.64	14.97	15.59	17.56	14.47	12.82

Actual landings per 10 hours by Aberdeen

trawlers...	12.54	6.60	12.54	14.31	11.67	7.94	14.46	13.56	16.03	18.05	14.11	12.44
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*) Estimated using data from RUSSELL, 1914.

Table 7. Mean Lengths and Standard Errors (S. E.) of

Year- Class	Age	Month	North-West			North			North-East			East		
			Mean	S. E.	No. of fish	Mean	S. E.	No. of fish	Mean	S. E.	No. of fish	Mean	S. E.	No. of fish
1952	0+	June												
		July												
		Nov.	15.8	0.135	206	14.8	0.120	203	13.0	0.140	161	13.6	0.169	10
	0+	Feb.	15.3	0.297	27	15.3	0.337	28	13.6	0.191	89	14.7	0.115	179
	0+	Mar.	16.2	0.860	5	13.7	0.565	7	15.1	0.286	42	14.8	0.216	58
	1+	April	—	—	—	—	—	—	—	—	—	15.2	0.135	159
1951	1+	May	17.0	1.000	2									
	1+	June	19.0	0.148	246	17.9	0.818	14	17.2	0.099	274	16.9	0.030	2911
	1+	July										19.5	0.206	63
	1+	Nov.	29.6	0.209	95	27.7	0.321	40	25.5	0.250	85	25.3	0.122	223
	1+	Feb.	29.9	0.249	187	30.3	0.185	253	26.8	0.411	36	25.7	0.207	142
	1+	Mar.	31.6	0.684	27	29.1	0.696	15	25.0	—	1	26.3	0.341	44
	2+	April	29.5	0.521	22							25.4	0.104	344
1950	2+	May	—	—	—									
	2+	June	31.5	0.292	161	29.2	0.299	60	26.4	0.403	39	26.6	0.147	332
	2+	July										32.9	0.885	20
	2+	Nov.	40.2	0.605	46	37.7	0.633	10	33.1	0.763	12	37.5	0.481	45
	2+	Feb.	40.2	0.234	178	40.7	0.268	124	36.1	0.691	26	37.1	0.279	85
	2+	Mar.	42.4	0.500	32	39.6	0.429	51	38.3	0.554	18	36.6	0.393	31
	3+	April	37.2	2.781	4							35.0	0.212	107
1949	3+	May	42.8	0.663	5									
	3+	June	43.0	0.498	55	35.9	0.753	22	35.7	0.951	31	32.7	0.372	119
	3+	July												
	3+	Nov.	46.6	1.893	10	—	—	—	42.0	1.000	2	47.8	1.510	13
	3+	Feb.	45.5	0.702	24	48.5	1.848	4	46.3	1.236	9	46.7	1.126	10
	3+	Mar.	54.2	4.367	4	46.9	0.804	13	47.6	0.503	34	47.2	1.470	11
	4+	April	47.7	1.221	10							41.3	2.027	3
1948	4+	May	46.0	—	1									
	4+	June	50.8	0.781	25	47.0	2.000	3	45.8	1.213	12	42.3	1.223	21
	4+	July												
	4+	Nov.	52.5	1.408	6	—	—	—	—	—	—	53.0	—	1
	4+	Feb.	—	—	—	—	—	—	52.0	—	1	—	—	—
	4+	Mar.	—	—	—	—	—	—	52.8	1.018	5	46.7	2.604	3
	5+	April	—	—	—	—	—	—				46.0	—	1
1947	5+	May	—	—	—									
	5+	June	54.0	—	2	—	—	—	59.0	1.155	3	47.5	3.500	2
	5+	July												
	5+	Nov.	—	—	—	—	—	—	—	—	—	65.0	—	1

converting these mean lengths to weights (using data from RUSSELL, 1914), and then multiplying each by the appropriate number per 10 hours' fishing (Table 6 A), estimates of the weights of each brood landed per 10 hours' fishing have been made (Table 6 C).

The commercial landings were composed of haddock of one to twelve years of age, of which the principal were of 1944, 1945, 1947, 1948, 1949, and 1950 broods.

The mean catch per 10 hours' fishing of the 1950 brood during 1952 was 389, as compared with a value of 443 per 10 hours' fishing for the 1949 brood during 1951. There would, there-

fore, appear to be little to choose between the relative strengths of these broods, neither of which, however, were nearly as good as the 1948 brood during 1950.

The 1952 brood, which was adequately sampled by "Scotia" in November, averaged 488 fish per 10 hours' fishing as compared with a figure of 538 per 10 hours' fishing of the 1951 brood during 1951. The 1952 brood then may be classed with the 1951 brood as "good".

Size composition.

The mean lengths and standard errors of each brood sampled by "Scotia", during each

Haddock of each Age-Group from Faroe - 1952.

Year- class	Age	Month	West			South			Sandø Bank			Faroe Bank		
			Mean	S. E.	No. of fish	Mean	S. E.	No. of fish	Mean	S. E.	No. of fish	Mean	S. E.	No. of fish
1952	0+	June							6.0	—	1	—	—	—
		July							Nil	—	—	—	—	—
		Nov.	14.1	0.485	14	14.2	0.242	44	13.2	0.167	48	—	—	—
	0+	Feb.	14.2	0.163	6				15.0	0.577	3	—	—	—
	0+	Mar.										—	—	—
	1+	April												
1951	1+	May												
	1+	June	20.0	—	1	18.1	0.485	14	17.8	0.308	51	20.2	0.248	52
	1+	July	19.0	0.024	4965				—	—	—			
	1+	Nov.	25.0	1.732	3	25.5	0.389	14	22.0	0.438	20			
	1+	Feb.	23.2	0.438	29				22.0	0.913	4	28.2	0.406	62
	1+	Mar.												
	2+	April												
1950	2+	May												
	2+	June	30.5	2.500	2	29.8	0.399	52	26.5	0.486	19			
	2+	July	30.2	0.045	2255				27.9	0.453	22	33.1	0.210	280
	2+	Nov.	34.0	2.000	2	38.5	0.500	2	33.1	0.889	14			
	2+	Feb.	34.6	2.249	5				32.5	1.500	2	44.9	0.880	28
	2+	Mar.												
	3+	April												
1949	3+	May												
	3+	June	—	—	—	41.2	0.901	15	34.9	0.900	12			
	3+	July	41.0	0.289	162				33.0	0.615	10	50.7	0.467	51
	3+	Nov.	—	—	—	52.0	—	1	38.0	1.342	5			
	3+	Feb.	43.2	2.871	5				37.0	2.000	2	—	—	—
	3+	Mar.												
	4+	April												
1948	4+	May												
	4+	June	48.5	2.500	2	51.0	2.095	9	42.0	—	1	67.0	—	2
	4+	July	50.0	0.389	38				—	—	—			
	4+	Nov.	53.0	—	1				44.0	1.155	3			
	4+	Feb.	59.0	—	1				—	—	—	—	—	—
	4+	Mar.												
	5+	April												
1947	5+	May												
	5+	June	—	—	—	—	—	—	—	—	—	71.0	—	1
	5+	July	59.2	0.872	6				—	—	—			
	5+	Nov.	—	—	—				—	—	—			

month, are shown in Table 7. As in previous years, the largest fish on the Faroe plateau were located in the north-west area, whilst the smallest were in the east, and in particular, on Sandø Bank.

Mortality rate.

An estimate of the mortality rate of each brood, over the years 1950, 1951, and 1952, has been estimated from the rates of decrease of the numbers per 10 hours' fishing of each brood taken in the commercial fishery. Estimates were made for each brood separately from

which it became apparent that the mortality rates of young fish (2—6 years) were consistently higher than those for older fish.

Mean annual mortality rates were:

1946—1948 broods 70% annually (range 67—74%)
1944 & 1945 broods 53% annually (range 53—54%)

The commercial fishery.

The average weight of haddock caught per 100 hours' fishing and landed by Aberdeen trawlers from Faroe during 1952 is shown in Table 8. The average of 124.8 cwts. per 100 hours' fishing for the year is practically the

Table 8. Landings of three Size Categories of Haddock by Aberdeen Trawlers from Faroe, 1952.

Month	Cwts. per 100 Hours				Total
	Hours Fishing	XL + L	Medium	Small	
January....	2676	55.2	29.1	41.1	125.4
February...	5385	46.4	12.2	7.5	66.0
March.....	8689	85.6	28.2	11.6	125.4
April.....	7348	86.5	36.9	19.8	143.1
May.....	3381	54.0	32.4	30.3	116.7
June.....	12354	34.6	18.5	26.4	79.4
July.....	12385	67.2	33.6	43.8	144.6
August....	8472	66.2	24.7	44.7	135.6
September..	8161	68.7	37.1	54.4	160.3
October....	1387	84.2	42.4	53.9	180.5
November..	3675	55.1	40.5	45.5	141.1
December..	12351	49.7	40.0	34.7	124.4
Total.....	86264				
Annual mean		61.1	30.4	33.2	124.8

XL = Extra Large L = Large.

same as that achieved during 1951 (125.7 cwts.). This was also true of the landings of each size category, and it may be concluded that there was little change either in density or age composition of the commercial stocks during these two years.

R. JONES and W. MAIN.

References.

- JONES (1951), *Ann.Biol.* 7, 1950.
 JONES and MAIN (1951), *Ann.Biol.*, 8, 1951.
 RUSSELL (1914), *Bd. Agric. and Fish. Inv.*, Ser. II, Sea Fish, 1, pt. I.

Lemon Sole.

In 1952 the landings of lemon soles at Aberdeen by British trawlers from Faroe amounted to 13,018 cwt. This total is less than the quantity landed in 1951 by 2,651 cwt. (17%). The catch was obtained during the course of 864 trips and 90,705 hours fishing, which are respectively 11% and 13% less than the corresponding figures for the previous year. The average catch per 100 hours' fishing for the year has been calculated as 14.4 cwt., which is 0.6 cwt. less than the 1951 average and thus illustrates the continuing decline in this figure from the record of 33 cwt. obtained in 1946. Another significant feature of the landings is the smaller average weight of large fish caught per unit of fishing time. In the course of the year the catch of fish

in this size category fell by 0.8 cwt. per 100 hours' fishing from 4.4 cwt. in 1951.

The fishing effort by English trawlers at Faroe also declined during the year by 11,482 (12%) hours' fishing. The total British trawling effort at Faroe in 1953 thus fell by 12 to 13% of the previous year's effort. This represents the first downward trend in the fishing effort observed since the end of the war.

F.R.S. "Scotia" paid seven visits to Faroese waters from mid-February to mid-November. In the course of 88 hours' trawling with a 30-foot trawl 386 lemon soles were caught, only eight of which were taken in the small mesh covering the cod-end. A summary of the size frequencies and the age composition of the fish are given in the accompanying table.

Size Frequencies.

Size group..	<26	26—30	31—35	36—40	41—45 cm
No. of fish..	69	91	153	65	8
Percentage..	17.9	23.6	39.6	16.8	2.1

Age Composition.

Year-class	1951	1950	1949	1948	1947	1946	1945	1944
No. of fish..	—	6	16	54	84	117	11	15
Percentage..	—	1.6	4.1	14.0	21.8	30.3	2.9	3.9

Year-class.....	1943	1942	1941	1940	1939	1938	1937
No. of fish.....	43	4	20	4	9	1	2
Percentage.....	11.1	1.0	5.2	1.0	2.3	0.3	0.5

The size frequencies resemble those of the last two years but include a rather higher proportion of fish in the 31—35 cm. group, i.e., fish of the small and medium market categories.

Fourteen different year-classes, for 1950 to 1937 inclusive, are represented in the age analysis. For the third year in succession the 1946 year-class (group VI) provides the highest number of fish of any single brood. Moreover, this year-class, with over 30% of the total catch, is considerably stronger than the next in importance numerically—the 1947 (V) and 1948 (IV) year-classes. As noted in previous reports the 1944 (VIII) and 1945 (VII) year-classes contributed relatively few fish to the stocks; of the older year-classes those of 1943 (IX), 1941 (XI), and 1939 (XIII) continue to reveal their superiority, although with steadily diminishing numbers.

B. B. RAE.

Rare Fishes.

The following rare fishes were landed at Aberdeen by commercial vessels from fishing

rounds in the North-Western Area during 1952.

1. *Macrurus fabricii*, SUNDEVAL:— one specimen off Cape Dan, E. Greenland, in June, three specimens SW. × S. from Sumbo Light, Faroe in August.

2. *Macrurus (Coryphaenoides) rupestris*, GUNNER:— one specimen WSW. of Westmann Isles in March.

3. *Mora mediterranea*, RISSO:— one specimen W. of Iceland in April.

4. *Brama raii*, BLOCH:— one specimen SW. of Syderø, Faroe, in August, two specimens on Bill Bailey's Bank in August, two specimens on Faroe Bank in August.

Further details of these records are included in a short paper on rare and exotic fishes landed in Scotland in 1952 which is in course of preparation.

B. B. RAE and E. WILSON.

Cod.

Iceland.

On the Spawning Stock in 1952.

Table 9 shows some of the most important features of the spawning stock of cod in 1952. The table, which is calculated in 10,000, is based on the age determinations of 4757 mature

cod caught on long-lines off the south-west coast of Iceland during January-May. All the following comparisons are made with the average lengths, age, etc. for the years 1930—52.

The general age distribution.

The 1942 year-class is still dominating the commercial catches. It entered the fishery as seven-year-olds in 1949, when it amounted to 14% of the samples. In 1950 it dominated the samples with about 41% and in 1951 it had risen to about 50%, but in 1952 it had passed its peak and constituted only 33% of the samples. This is not a strong year-class, but because of the weakness of the stock as a whole it has dominated it to such an extent. The 1922 year-class gave 173 cod per 1000 hooks of 8—9-year-olds, but the 1942 year-class gave only 77 cod per 1000 hooks. As compared with the younger age-groups, the 1945 year-class, now eight-year-olds, is a most promising one. In 1952 it made 12.3% of the total (the 1930—52 average is 6.1%). If we examine this year-class closer, we see that it consists of 88.4% of recruits (the 1930—52 average is 79.8%), 11.3% were spawning for the second time, and 0.3% spawning for the third time. These figures tell us, that this year-class is getting mature somewhat older than the average. This is also confirmed by the length (76.9 cm.), which is 2.3 cm. lower than

Table 9. The Composition of the Spawning Stock of Cod in 1952.

Age-Group	Age at first spawning												Total
	4	5	6	7	8	9	10	11	12	13	14		
IV.....	46	—	—	—	—	—	—	—	—	—	—	46	
V.....	13	149	—	—	—	—	—	—	—	—	—	162	
VI.....	—	27	338	—	—	—	—	—	—	—	—	365	
VII.....	—	4	139	1085	—	—	—	—	—	—	—	1228	
VIII.....	—	—	15	244	1219	—	—	—	—	—	—	1478	
IX.....	—	—	—	107	629	1400	—	—	—	—	—	2136	
X.....	—	—	6	101	908	1379	927	—	—	—	—	3321	
XI.....	—	—	4	13	40	90	50	19	—	—	—	216	
XII.....	—	—	2	17	25	67	38	21	2	—	—	172	
XIII.....	—	—	—	11	19	13	32	25	11	—	—	111	
XIV.....	—	—	—	4	32	48	29	19	17	6	—	155	
XV.....	—	—	—	1	6	25	25	11	8	2	—	78	
XVI.....	—	—	—	6	69	95	101	74	55	4	—	404	
XVII.....	—	—	—	2	4	6	11	19	6	6	2	56	
XVIII.....	—	—	—	2	8	6	23	13	2	—	2	56	
XIX.....	—	—	—	—	—	—	2	2	2	—	—	6	
XX.....	—	—	—	—	—	—	2	—	—	—	—	2	
XXI.....	—	—	—	—	—	—	—	4	—	—	—	4	
Total No. .	59	180	504	1593	2959	3129	1240	207	103	18	4	9996	
Spawning classes													
	1	2	3	4	5	6	7	8	9	10	11	12	Total
No.....	5185	2519	1206	273	160	193	192	131	101	18	16	2	9996

Table 10. Age Distribution of the Recruit Spawners in 1952.

Month	Age-Groups									No.	%
	IV	V	VI	VII	VIII	IX	X	XI	XII		
January	5.6	15.8	30.5	18.1	20.3	5.1	4.0	0.6	—	177	47.3
February	0.8	6.1	11.5	23.1	20.4	21.3	16.2	0.4	0.2	494	37.9
March	0.3	1.1	5.4	18.5	25.9	27.4	20.9	0.4	—	702	45.2
April	0.5	0.5	1.1	22.2	24.4	31.7	19.1	0.4	—	823	70.8
May	0.7	—	1.1	21.0	22.1	36.5	18.5	—	—	271	74.9
Jan.—May	0.9	2.9	6.5	20.9	23.5	27.0	17.9	0.4	—	2476	51.9

the 1930—52 average. Of this year-class there are 1085 recruit spawners out of 10,000 or 2.2 times higher than the 1930—52 average. The 1946 and 1947 year-classes are also promising ones, since they both show a great number of first-time spawners. The older part of the stock is of no importance. There are only 12.7% of the age-groups XI—XXI and of these the 1936 year-class makes 4%. These age-groups will be reduced to about 6% in 1953.

The recruit spawners.

The recruit spawners form a very important part of the spawning stock. From the spawning zones in the otoliths we are able to study the age at first spawning. Table 10 shows the age distribution of the recruit spawners in each month, together with the percentages of the total sampled in each month. In the table we see that the percentages of the recruits are increasing during the spawning season. The old-time spawners appear first on the spawning grounds in January, but about the middle of March the recruits arrive in great quantities and after March their number is fairly constant, being about 75% of the total. The age composition of the recruits is rather constant during the season, except in January when there are some irregularities, because these samples are mostly based on local fish of southern origin.

The recruits form about 52% of the total, which is high for fish caught on long-line (the 1930—52 average is 38.2%). There are more of the age-groups IV—X than usual, but the deviations are greatest for the age-groups IV—VII. Normally these age-groups give 2138 first-time spawners out of 10,000 for the next year, but in 1953 these are expected to give 4666 first-time spawners. The percentage of first-time spawners as a whole is supposed to be about 58% in 1953.

There is a very regular decrease in the number of the first three spawning classes,

showing about 50% reduction. There are only 11% of the older spawning classes. The sixth to eighth classes are relatively well represented on account of the 1936 year-class which is now mostly spawning for the seventh to ninth time.

Prediction.

As mentioned in a previous report (Ann. Biol. Vol. VIII, 1951), we have in the last few years tried to predict the fluctuations in the mature part of the stock one year in advance. Figure 28, in the report mentioned, shows the observed and the calculated age distribution in the years 1948—52. On Figure 24 in the present report I have added the actual values found for 1952 and the predicted age composition for 1953. There is somewhat slighter agreement in 1952 than in 1951, especially for the age-groups VIII—X where there are some discrepancies. The closer study of these is of the greatest importance. This prediction is based on a total mortality of 50% and a number of fixed maturity factors found as the average for the years 1930—51. A thorough study, however, has shown that there are considerable variations in the onset of maturity of the different year-classes. The big year-classes as a rule show slow growth correlated with a late onset of maturity. Work is now going on attempting to weed out errors caused by this. The distribution of the samples according to time is also of the uttermost importance. As a rule the older fish first arrive on the spawning grounds with relatively low percentages of recruit spawners. Prediction based on such a sample, therefore, will give too many of the older fish and too few of first-time spawners for the following year. During the last years we are taking samples every other or every third day from different places where the fishery is carried on. Such sampling gives us the main variations in the composition of the stock

Migrations of Cod from Iceland to Norwegian Waters.

In the years 1948—52 about seven thousand cod have been marked in 51 marking experiments all around the coasts of Iceland. In the first two years most of these were marked outside the spawning grounds, mostly off the north coast, but in 1951 and 1952 marking experiments have also been carried out off the south and west coast during the spawning season. The results of these markings will not be dealt with here, but I shall only give a short account of the interesting fact that three young cod marked off the north coast in August-September 1949 and 1950 have been recorded as recaptured off northern Norway.

The following particulars are at hand:—

No. ISL 2844 marked in Eyjafjörður (66°06'N.—18°20'W.) (Mrk. No. 9) in 72—90 m. depth, 3. September 1949. Length at marking 61 cm., 6 years old. Recaptured in February 1951 off the Norwegian coast (location not certain). Length at recapture 74 cm., age 8 years. Caught by a German trawler. Information from "Institut für Meeresforschung", Bremerhaven.

No. ISL 3097 marked in Skagafjörður (65°56'N.—19°33'W.) (Mrk. No. 11) in 36—90 m. depth, 7. September 1949. Length at marking 69 cm. Recaptured off Lofoten 16. March 1951. Length at recapture 70 cm. Weight gutted 6 kg. Caught by a German trawler. Information from A. KOTTHAUS, Bremerhaven.

No. ISL 4481 marked in Skjálfandi Bay (66°03'N.—17°33'W.) (Mrk. No. 20) in 36—90 m. depth, 22. August 1950. Length at marking 62 cm., 5 years old. Recaptured off Vardø or Andenes in January 1952. Age at recapture 7 years. Caught by a British trawler. Information from Marine Laboratory, Aberdeen.

As far as I know, these are the first recaptures of fish outside Icelandic waters which were not marked on the spawning grounds. According to Å. VEDEL TÅNING, 1937¹⁾ two cod, marked in Icelandic waters, have been recaptured in Norwegian waters. Both were marked off the south coast during the spawning season, but no further particulars are given. Figure 24 shows the recaptures in Icelandic waters from the above-mentioned experiments. The typical feature of the immature cod is clearly seen from the figure. They are stationary until they become mature, after which they migrate to the spawning grounds in warmer waters off the south coast.

¹⁾ "Some Features in the Migration of Cod". Journ. du Cons., 12, 1.

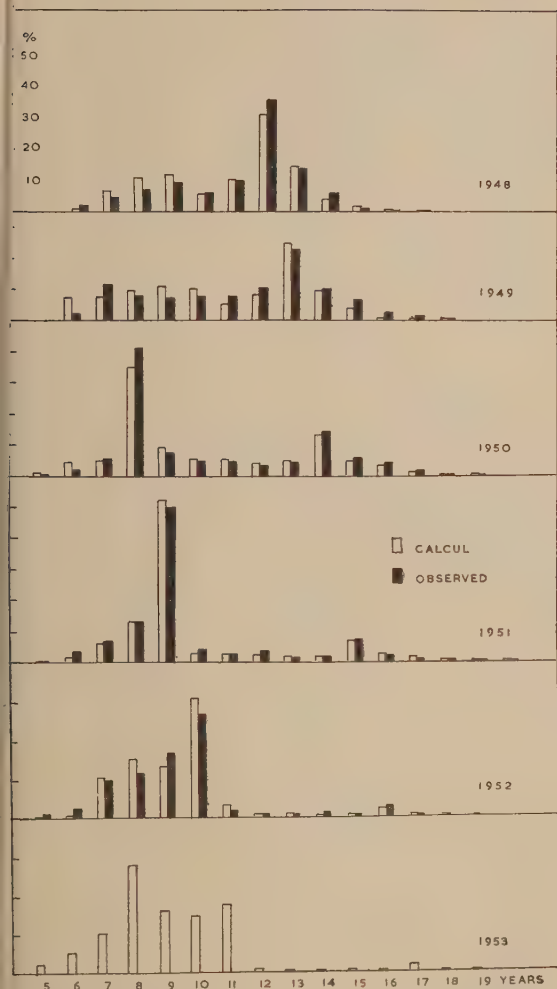


Figure 24. Comparison between the observed and calculated age distribution of cod in the years 1948—53.

during the spawning season. Each sample consists of 100 or 200 otoliths together with information on length, sex, maturity etc.

In 1953 the dominating age-group is supposed to be the year-class of 1945, 8 years old. It should make about 28% of the total catch. The age-groups IX—XI will each give 15—18%. As mentioned before the age-groups XI—XXI shall be reduced to about 6%. The number of recruit spawners should be rather high totalling 58%.

The size of the stock should increase to about 20% compared with the year before.

JÓN JÓNSSON.

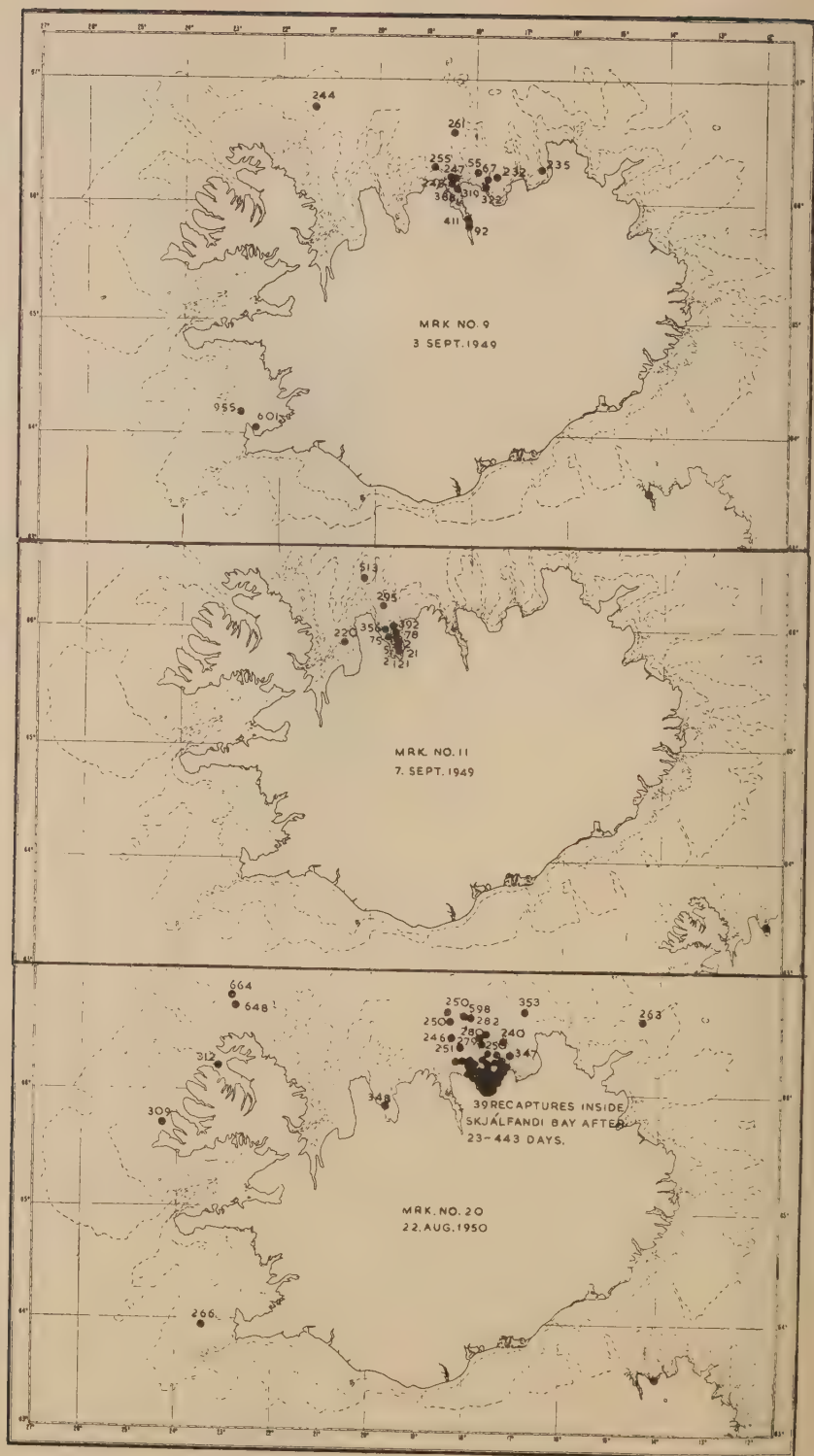


Figure 24 a. Records of recaptures from experiments Nos. 9, 11, and 20.
Locality of tagging is shown in the right-hand bottom corner.

There are two ways on which these cod may have left Icelandic waters, either directly from the north coast, or they may first have migrated to the south coast for spawning and have gone from there to Norway.

The number of days at liberty is remarkably alike for all the recaptures. These were made after about 500 days. We do not know when they left Icelandic waters, so an explanation based on currents is rather doubtful, but the similarity of the number of days at freedom is very striking.

JÓN JÓNSSON.

Haddock.

Notes on the Haddock in Faxa Bay during the Summer of 1952.

During June—August 1952 there was a considerable number of small haddock in the southern part of the Faxa Bay. The fishing was carried out on a small scale by means of hand-lines from small open motorboats, as any kind of trawling and seine-netting in the bay is now prohibited. The catches were mostly landed in Reykjavik and Akranes. In Akranes 802 fish were measured and age analysed by means of the otoliths. The result is shown in Table 11 and Figure 25.

Table 11. Age and Size of Haddock, Faxa Bay, June-July 1952.

Year-class	Age	Number	%	Av. length (cm.)
1950.....	2 years	1	0.1	35.00
1949.....	3 —	717	89.5	41.96
1948.....	4 —	11	1.4	51.45
1947.....	5 —	18	2.2	57.17
1946.....	6 —	22	2.7	59.18
1945.....	7 —	27	3.4	63.67
1944.....	8 —	5	0.6	68.40
?	? —	1	0.1	31.00
Total.....		802	100.0	43.76

The size ranged from 30—80 cm. and the age from 2 to 8 years. The reason for this material being mentioned here, is the fact that a single year-class proved to be of outstanding importance. This was the 1949 year-class, which was 3 years old. It formed 89.5% of the catches and the average length was 41.96 cm. Without this year-class there would practically have been no haddock fishing at all. This appears clearly from the figure, where the size distribution is shown at the top and the age distribution at the bottom. The size distribution

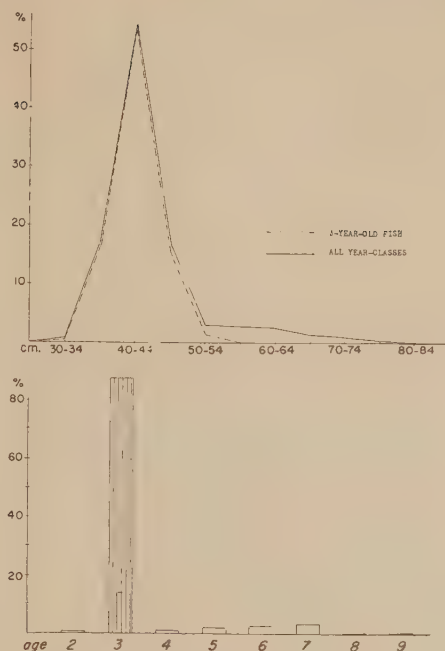


Figure 25. Size and age of haddock caught on hand-line in Faxa Bay during the summer of 1952.

of the 3-year-old fish is also given. It is worth noting that the age of the fish is nicely reflected in the size distribution.

ÁRNI FRÍÐRIKSSON.

Saithe.

Remarks on the young Saithe (*Gadus virens*, LINNÉ) off the North Coast of Iceland.

In the summer of 1952, as also during the two previous summers, considerable quantities of saithe were landed in Siglufjörður, N. Iceland. The catches were taken in purse-seines and processed to oil and meal in the herring processing plants. The fishing was not, as in 1950 and 1951, concentrated off the middle of the north coast but took place all along the eastern part of the coast from Skagafjörður to Langanes. The total amounts of saithe, taken in purse-seine, have been:— 1950, 10,000 tons (wet weight); 1951, 2,130 tons¹⁾; 1952, 6,396 tons.

¹⁾ In Ann.Biol. 8, p. 43 the total catch for 1951 was said to have been 1891 tons. This was, however, not the final figure for that year.

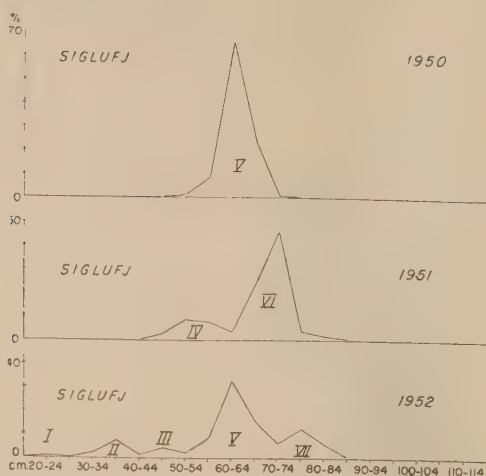


Figure 26. Size composition of saithe (cm.) caught in purse-seine off North Iceland in 1950-52.

In order to get a clear survey of the size composition of the catches 5600 fish were measured and 500 were sampled for otoliths to check the age.

In Figure 26 the size composition is shown the two previous seasons being included for comparison. As mentioned earlier (Ann. Biol. VIII, p. 43) there was only one peak at 60-64 cm. in 1950, but in 1951 there were two, one at 50-54 cm. and the other at 70-74 cm. This is clearly seen from the figure. In 1952 however, there were not less than 5 peaks, corresponding to 20-24 cm., 35-39 cm., 45-49 cm., 60-64 cm., and 75-79 cm. The peaks correspond to age-groups (I, II, III, V, and VII), as is indicated by roman numbers in the figure. The age analysis has also proved this, as can be seen from Figure 27, where the age composition from year to year is given. In 1950 the catches consisted nearly entirely of one year-class (1945), which was 5 years old, but in 1951 we note an additional brood, being from 1947. In 1952 this year-class, then five years of age, constituted the main bulk of the catches, contributing more than 60%.

A closer look at the figure reveals that seven year-classes could be noted last summer, aged I-VII, and originating from the 1945-1951 year-classes. One- and four-year-old fish are just present, and there are also only few six-year-olds. On the other hand the V-group is by far the strongest (60.4%) followed by the VII-group (12.0%). The II- and III-groups were present in 10.8 and 9.6% but were of relatively little value owing to their small size.

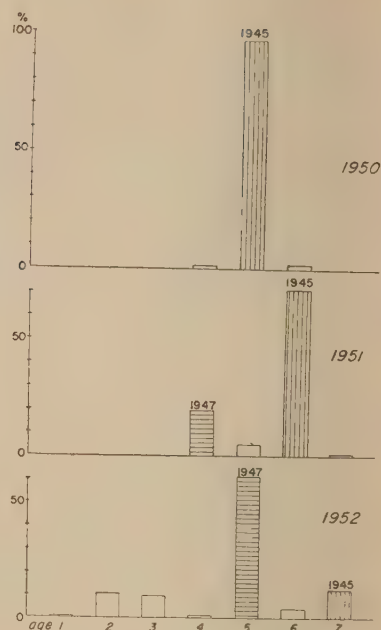


Figure 27. Age composition of saithe caught in purse-seine off North Iceland in 1950-52.

As pointed out last year (Ann. Biol. Vol. VIII) the increase in this fishery was entirely due to the abundance of the 1945 year-class without which there would have been no fishing in 1950 and hardly any in 1951. This year-class seemed however to have left the northern grounds between the seasons of 1951 and 1952, probably some left already a year earlier. The slow growth between 6 and 7 years age (see Table 12), indicates that the fish has been mature at the age of 6 years and that in turn, seems to be the reason for their leaving. After spawning, off the south coast in the spring of 1952, they have not migrated to the north to any appreciable extent.

Table 12. Age and Size of Saithe off the North Coast of Iceland in 1952.

Year-class	Age-group	Number	%	Av. length (cm.)
1951.....	I	1	0.2	25.00
1950.....	II	54	10.8	35.65
1949.....	III	48	9.6	46.36
1948.....	IV	5	1.0	55.00
1947.....	V	302	60.4	62.19
1946.....	VI	23	4.6	74.00
1945.....	VII	60	12.0	76.77
?	?	7	1.4	45.71
Total.....		500	100.0	59.77

Besides the 1945 year-class there has only been one other predominating year-class, that of 1947. Next summer it can perhaps be expected to yield good catches again but the fishing in future seasons will depend entirely upon the appearance of new, strong year-classes.

ÁRNI FRÍÐRIKSSON.

Redfish.

Notes on the *Sebastes marinus* (LINNÉ) and the Icelandic Redfish Fishery west of Iceland.

During 1952 the main redfish season was in June, July and August. The greatest quantities were landed in Akranes (Faxa Bay) and the fishing grounds were far offshore, west of Iceland, as usual near the cold-water border. Material was collected from 10 trips during the period 19. June to 6. August, and the total catch from these trips amounted to 2530 tons of redfish (wet weight) and 2787 tons including other species. 10,000 fish were measured and otoliths were collected from 1000 for later age determination.

In the last volume of Ann. Biol. (VIII, p. 47) a survey was given of the compositions of the catches from the redfish grounds throughout the year 1951. A similar analysis, covering 8 trips, was carried out in 1952, the result being as shown in Table 13; only 8 species were recorded.

As can be seen from the table the redfish was the principal species in every trip making 88.1—99.5% of the total yields or an average of 94.1%. Next in importance was the saithe, which in one trip (11. July) yielded 8.4% of the

Table 14. Survey of the Size of the Redfish
1950—52 (%).

cm.- groups	1950		1951		1952	
	Akran. Nov.	Sigluf. Aug.	Akran. Nov.	Akran. June	Akran. July	Akran. Aug.
≥ 50.	9.5	9.5	2.8	23.0	5.5	5.0
45—49.	31.0	26.8	19.3	25.4	17.3	16.8
40—44.	41.0	49.0	55.3	27.8	32.2	29.8
< 40.	18.5	14.7	22.6	23.8	45.0	48.4
Total.	100.0	100.0	100.0	100.0	100.0	100.0

total. It is especially worth mentioning that the great silver smelt (*Argentina silus* ASCANIUS) was taken in considerable quantities in July and August. This fish was first reported from Iceland in 1903 and in his work about Icelandic fishes in 1926 SÆMUNDSSON states that 10—12 specimens may sometimes be caught in a single haul by the commercial trawl¹). During my trips with the patrol vessel "Þor" in 1936—38 on one occasion 192 fish were caught in one haul and records from trawlers made it clear that this species was by no means rare in those years. As can be seen from Table 13 the smelt might yield from 5 to 6% of the total in 1952 (by weight). It was processed to oil and meal. It appeared in quantities during 2. July to 6. August. The total weight caught amounted to about 60 tons and nearly 21 tons were taken during a single trip.

In Table 14 a survey is given of the size distribution of the redfish by months through 1950—52. In order to get a clear comparison the fish have been divided into four size categories: "large", exceeding 49 cm., "medium

¹) B. SÆMUNDSSON: "Íslenzk dýr I. Fiskarnir". Reykjavík, 1926.

Table 13. Market Analyses of Trawl Catches from the Redfish Grounds off west Iceland in 1952 (%).

(The dates are days of landing).

Species/Date	19/VI	23/VI	27/VI	2/VII	11/VII	16/VII	20/VII	6/VIII	Average
Redfish.	99.5	99.1	90.5	90.0	88.1	92.9	94.2	92.1	94.1
Cod.	—	0.1	0.6	0.2	—	—	—	0.1	0.1
Saithe.	—	0.4	7.1	3.0	8.4	3.4	—	1.0	3.6
Ling ¹).	—	0.1	0.8	0.7	0.3	—	3.2	—	
Torsk.	—	0.2	0.5	—	—	0.8	—	1.6	
Catfish.	—	0.1	0.3	0.3	0.3	0.4	—	0.4	0.2
Halibut.	+	+	0.2	+	0.1	—	0.1	0.2	0.1
Great Silver Smelt ²).	0.5	—	—	5.8	2.8	2.5	2.5	4.6	1.9
Totals.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

¹) Mostly *Molva byrkelange*.

²) *Argentina silus*.

the fish,—one would assume the whole of the stock to be affected if it is due to the fishing operations. Further investigations are therefore needed in order to solve the problem.

A. FRIDRIKSSON.

Rare Fishes.

In recent years the "Institut für Meeresforschung—Bremerhaven" (IFM), the Bremerhaven-F station of the "Biologische Anstalt Helgoland" (BAH) and the "Institut für Seefischerei—Hamburg" (IS) have received a great number of rare fishes; some of them had been collected during the cruises, but most of them were supplied by interested fishermen. By far the greatest number of these catches came from the "Rose-Garden" fishing ground on the Iceland—Faroe ridge, where rare fishes proved to be very abundant, but, off the south, west, and north-west coasts of Iceland remarkable catches were made also. Various species (marked by an asterisk) seem to be new for the area, since they are not mentioned in the "Fishes" volume of the "Zoology of Iceland" (SÆMUNDSSON 1949); further two novel species were found and described.

During 1952, the institutes have received the following species (their number is given in brackets after the date of capture):—

1. *Aphanopus schmidtii* SÆMUNDSSON 1907
20. 8. 52 (1), 63°20' N. 12°30' W. (IFM).
2. *Beryx decadactylus* C. & V. 1829
16. 9. 52 (1), Iceland—Ingolfshöfði (IFM).
3. *Brama rayi* BLOCH 1791
28. 8. 52 (1), Iceland—Skeidarardeep (IFM).
5. 9. 52 (1), Iceland—Ingolfshöfði (BAH).
14. 9. 52 (1), Rose-Garden (IFM).
15. 9. 52 (4), Iceland—Ingolfshöfði (BAH).
16. 9. 52 (1), Iceland—Ingolfshöfði (IFM).
18. 9. 52 (1), Iceland—Berudeep (IFM).
4. *Centrolophus britannicus* GÜNTHER 1860
14. 11. 52 (1), Rose-Garden (IS).
5. *Chauliodus sloani* BLOCH & SCHNEIDER 1801
8. 8. 52 (2), Rose-Garden (IS).
3. 9. 52 (1), Rose-Garden (IFM).
- 6.* *Gonostoma elongatum* GÜNTHER 1878
9. 8. 52 (1), Rose-Garden (IS).
- 7.* *Hoplostethus islandicus* KOTTHAUS 1952
8. 1. 52 (1), Iceland—Vikuralbank (BAH).
- 8.* *Howella shernborni* (NORMAN 1930)
9. 8. 52 (1), Rose-Garden (IS).
- 9.* *Nemichthys scolopaceus* RICHARDSON 1848
3. 9. 52 (1), 64°N. 11°40' W. (IFM).
- 10.* *Nesiarchus nasutus* JOHNSON 1862
27. 6. 52 (1), and 10. 7. 52 (1), Rose-Garden (IFM).
12. 9. 52 (1), Rose-Garden (IS).
18. 9. 52 (1), Iceland—Berudeep (IFM).

11. *Notacanthus chemnitzii* BLOCH 1788 (probably identical with *Notacanthus phasganorus* GOODE 1881); see D. W. TUCKER & J. W. JONES:
On a rare deep-sea fish *Notacanthus phasganorus* GOODE; Bull. Brit. Mus. Nat. Hist., Zool. Vol. 1, No. 5)
7. 8. 52 (1), "Island" (IS).
9. 8. 52 (1), Rose-Garden (IS).
- 12.*) *Notacanthus phasganorus* GOODE 1881
22. 2. 52 (1), Iceland—Westmann Isles (IFM).
10. 7. 52 (1), 14. 7. 52 (1), 8. 9. 52 (1), 24. 9. 52 (1), Rose-Garden (IFM).
13. *Stomias ferox* REINHARDT 1842
8. 8. 52 (1), Rose-Garden (IS).
- 14.*) *Xenodermichthys copei* (GILL 1884)
8. 8. 52 (11), Rose-Garden (IS).
3. 9. (1), 64°N. 11°40' W. (IFM).

The following finds, from 1948—1951, may be noted:—

- 1.*) *Alepocephalus bairdii* GOODE & BEAN 1879
8. 8. 50 (1), 62°40' N. 9°W. Rose-Garden-South (IS).
11. 7. 51 (1), Rose-Garden (IFM).
2. *Alepocephalus* sp.
June 1949 (1), Iceland—Ingolfshöfði (BAH).
- 3.*) *Aphanopus carbo* LOWE 1839
10. 5. 51 (1), Iceland—Lönsdeep (BAH).
30. 6. 51 (1) and 7. 7. 50 (1), Rose-Garden (BAH).
4. *Aphanopus schmidtii* SÆMUNDSSON 1907
30. 6. 51 (1) and 2. 7. 51 (1), Rose-Garden (BAH & IFM).
16. 7. 51 (1), 63°45' N. 12°30' W. (IFM).
27. 2. 51 (1) and June 1951 (3), Rose-Garden-South (IS).
- 5.*) *Beryx decadactylus* C. & V. 1829
6. 7. 51 (1), 66°44' N. 24°46' W. (BAH).
1. 11. 51 (1), Iceland—Gammelloch (BAH).
6. *Brama rayi* BLOCH 1791
27. 8. 51 (1) and 28. 8. 51 (1), Iceland—Ingolfshöfði (IFM & BAH).
6. 9. 51 (1), 63°15' N. 20°05' W. (IFM).
3. 12. 51 (1), Iceland—Berudeep (IFM).
7. *Centrolophus britannicus* GÜNTHER 1860
22. 9. 48 (2), Rose-Garden (BAH).
8. 8. 50 and 28. 8. 50 (each 1), Rose-Garden (IS).
18. 6. 51 (2), Iceland—Vikural (BAH).
13. 7. 51 (1), 16. 7. 51 (1), and 22. 7. 51 (3), Rose-Garden (IFM).
8. *Centrolophus niger* GMELIN 1788 (= *C. pompilus* Risso 1810).
2. 10. 48 (1), 64°20' N. 11°13' W. (IS).
7. 7. 51 (1), 63°47' N. 12°20' W. (IFM).
9. *Ceratias holboellii* KRØYER 1844
May 1950 (1), Rose-Garden (BAH).
14. 7. 51 (1), 63°35' N. 11°46' W. (IFM & BAH).
10. *Chauliodus sloani* BLOCH & SCHNEIDER 1801
4. 7. 51 (1), Rose-Garden (BAH).
11. *Haloporphyrus* sp.
1.—5. 7. 51 (ca. 50), Rose-Garden (BAH).
- 12.*) *Hoplostethus islandicus* KOTTHAUS 1952
Nov. 1949 (5), Iceland—Oeräfadaground (BAH).
15. 1. 51 (23), Iceland—Medallandbay (BAH).
19. 1. 51 (8), Iceland—Skaftardeep (BAH & IFM).
21. 12. 51 (1), Iceland—Vikural (BAH).
- 13.*) *Lampadena braueri* ZUGMAYER 1914
28. 8. 50 (4), Rose-Garden (IS).
- 14.*) *Lampanyctes ater* TÄNING 1928
28. 8. 50 (1), Rose-Garden (IS).
5. 7. 51 (2), Rose-Garden (BAH).

15. *) *Nesiarchus nasutus* JOHNSON 1862
6. 7. 51 (1), Rose-Garden (IFM).
16. *) *Notacanthus chemnitzii* BLOCH 1788 (see note to No. 11, top of p. 47).
7. 6. 50 (1), 1. 10. 50 (1), 23. 5. 51 (1), 7. 7. 51 (1), Rose-Garden (IS).
17. *) *Notacanthus phasganorus* GOODE 1881
8. 7. 50 (1), Iceland—Portland (IFM).
9. 5. 51 (2), Rose-Garden (IFM).
2. 6. 51 (3), 62°55' N. 11°55' W. (IFM).
20. 6. 51 (1), Rose-Garden (IFM).
22. 6. 51 (8), 63°50' N. 12°30' W. (IFM).
6. 7. 51 (2), Rose-Garden (IFM).
5. 7. 51 (2), 63°47' N. 12°20' W. (IFM).
10.—13. 7. 51 (5), 63°32' N. 12°40' W. (IFM).
14. 7. 51 (4), 63°11' N. 11°10' W. (IFM).
14. 7. 51 (1), Rose-Garden (IFM).
18. *) *Paralepis coregonoides borealis* REINHARDT 1838
June 1951 (1), Rose-Garden (IS).
19. *Paralepis risoi krøyeri* LUETKEN 1892
June 1951 (1) & 11. 10. 51 (1), Rose-Garden (IS).
20. *) *Paraserriromer hasta* (ZUGMAYER 1911)
28. 8. 50 (2), Rose-Garden (IS).
21. *) *Searsia schnakenbecki* KREFFT, n. sp. (original description in print) probably identical with the species described by FRIDRIKSSON as *Searsia* sp.
28. 8. 50 & June 1951 (6 and 3), Rose-Garden (IS).
22. *Stomias ferox* REINHARDT 1842
4. 7. 51 (1), Rose-Garden (BAH).
23. *) *Xenodermichthys copei* (GILL 1884) (= *X. socialis* VAILLANT 1888)
28. 8. 50 (3) and June 1951 (3), Rose-Garden (IS).
5. 7. 51 (2), Rose-Garden (BAH).

C. H. BRANDES,
A. KOTTHAUS,
G. KREFFT.

Cod.

Greenland.

Cod in West-Greenland Coastal Waters and Offshore Banks 1952.

1. Eggs and fry.

In Figure 30 are given the catches of cod eggs taken by the "Adolf Jensen" in April and May with the 1-m. stramin net. Figure 31 shows the catches of cod larvae taken by the "Dana" in July with the 2-m. stramin net.

While relatively large numbers of cod eggs were taken in the inner part of Godthåb Fjord only a few were taken in the outer part of the fjord and on Fylla Bank, where the number of cod eggs taken only amounts to 58 on the middle of the bank and 85 on its western edge. In 1950 491 and 566 cod eggs were taken in the same month and on corresponding stations on Fylla Bank.

The numbers of cod larvae taken from the "Dana" in July 1952 were very small com-



Figure 30. Catches of cod eggs.

pared with the numbers taken in the same month in 1950 (Ann. Biol. 1950, p. 38). It appears that the conditions for survival of cod larvae in Davis Strait were unfavourable in 1952 and it is therefore possible that the 1952 year-class will be poor and will not contribute very much to the output of the fishery in the future.

It appears from catches of small cod with the hand-seine in the coastal region that the 1950 year-class is fairly rich, which agrees well with the comparatively large numbers of cod larvae taken by the "Dana" in Davis Strait in 1950.

2. The age composition.

(a) The material. On the "Dana" a material of 1500 otoliths of cod was taken at 15 different stations over the fishing banks. On the "Adolf Jensen" about 2453 otoliths were collected in Godthåb Fjord and Ameralik Fjord in Godthåb district, from Amerdlok Fjord in Holsteinsborg district and from localities in Julianehåb district. Besides the collections made from the research ships, about 3000 otolith samples were collected from the Greenlanders' catches at many different fisheries stations along the coast. The total number of otolith samples collected in 1952 amounts to about 6900. Up to the time of writing 3885 have been read.

(b) The composition of year-class percentages in the different samples are given on the map (Figure 32). On the map the different samples are numerated with roman numerals



Figure 31. Distribution of cod fry. Nos. per $\frac{1}{2}$ hour hauls. 100/200 m. oblique hauls. x negative hauls.

which will be referred to in the following. To make it easy to compare the different samples the 1945 year-class is given in white columns while the 1942 year-class is given in shaded columns.

The collections of otoliths come from cod taken by different methods. All the collections taken by the "Dana" come from cod taken with hand-line (IV and X—XV). The samples collected at the Greenland fishery stations come from cod taken mainly with long-lines (I—III, VI—VII, and XVI—XIX) or from pound nets (V). On some stations the material is derived from cod taken with different gears such as hand-lines, long-lines and shrimp-trawl (VIII and IX).

It is seen that only three year-classes dominate in the samples from the offshore banks (X—XV) namely the year-classes 1942, 1945 and 1947. The two last mentioned year-classes are especially rich while the year-class 1942, which was a very important year-class on the banks in three previous years (RASMUSSEN, Ann. Biol. 1951, pp. 51—53), is only of slight importance in 1952. Only in one sample on the western edge of Store Hellefiske Bank (XI) this year-class amounts to between 25 and 30 percentages of the sample. In the samples from both Store and Lille Hellefiske Banks (X and XII) the 1947 year-class is the dominant one. In the samples from Fylla Bank (XIII) and Fiskenes Bank (XIV) this year-class and the 1945 year-class are of about equal importance, while on Dana Bank (XV) the 1947 year-class alone amounts to less than 10%.

In the samples north of 69° N.L. (I—IV) the composition of year-classes is quite different from that in the banks samples. In this region the three year-classes 1934, 1936 and 1942 are dominant.

In the samples from Umanak Fjord (I) and Jakobshavn (III) the year-classes 1934 and 1936 together amount to between 30 and 40 of the total percentage while they are present in very small amounts in two other samples (II and IV). The richest year-class in this northern region is the 1942 year-class. The two year-classes 1934 and 1936 have predominated in West Greenland waters during a long period, i.e., from 1940 to 1949. In 1950 they were replaced by the 1942 year-class.

In the coastal waters and in the fjords the two samples from Holsteinsborg district (V and VI) are very much alike and are also very similar to the samples from Store Hellefiske Bank (X). The 1947 year-class is by far the richest. The sample from Sukkertoppen shows a more even distribution than the sample from Holsteinsborg.

Godthåb Fjord (VIII) and Ameralik Fjord (IX) have cod stocks which are very much alike as regards year-class composition. Especially the former has a very even distribution of the different year-classes which bears further evidence (together with the otolith type and slow growth-rate) to the assumption that the fjord has a local population. This fact is also proved by tagging experiments. In Ameralik Fjord (IX) as already mentioned, the com-

1952

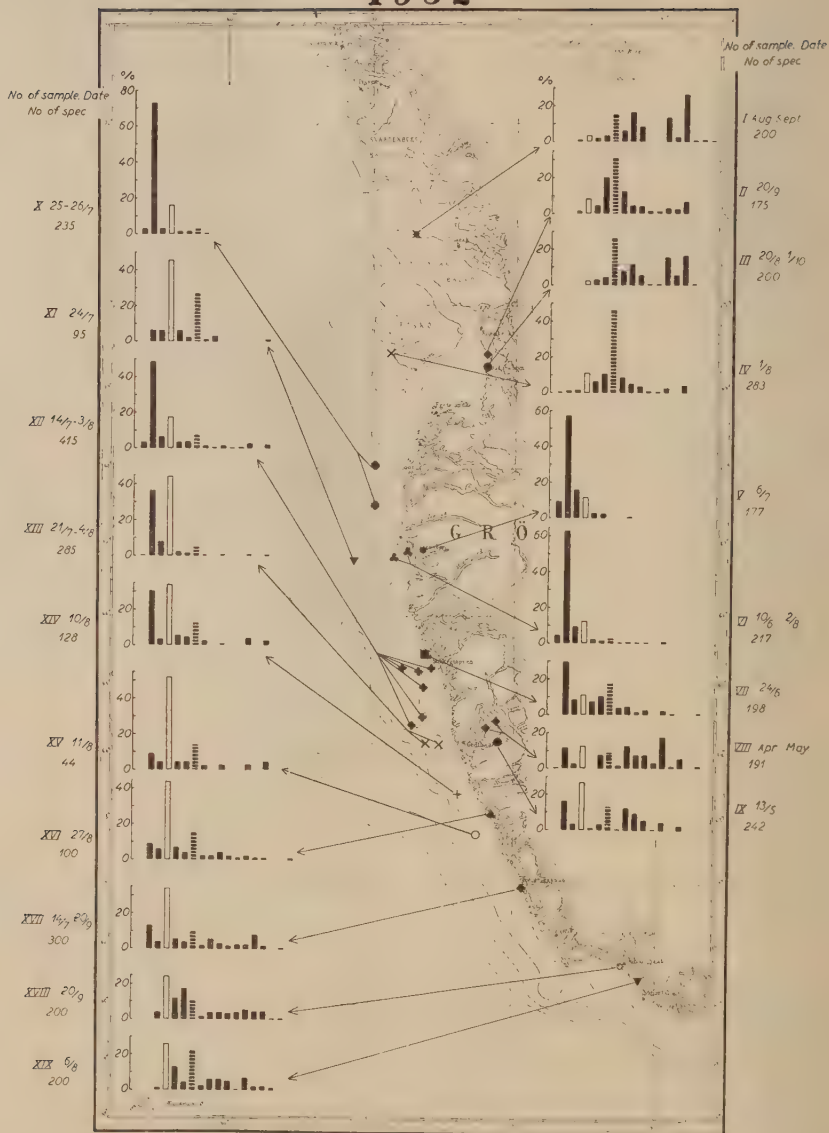


Figure 32. Composition of year-classes.

position of year-classes in the catches is very similar to that of Godthåb Fjord. The otolith types in the two fjords are also very much alike (fjord cod type) with many secondary rings, which make age determinations very difficult. The growth-rates, however, are very

different in the two fjords, being very slow in the Godthåb Fjord while the Ameralik Fjord cod has about the same rate as the cod on the banks (see Table 16). In Ameralik Fjord the cod occur only in May to June pursuing the spawning capelin. During the last part of June

Table 16. Mean Lengths of the 1947, 1945 and 1942 Year-Classes calculated from Material for 1952.

Locality	No. on Fig. 32	Date	1947		1945		1942	
			♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
Off Disko Fjord.....	IV	1. Aug.....	—	—	69.5 (12)	69.4 (20)	77.9 (50)	81.5 (80)
St. Hellefiske Bank...	X	25. & 26. July..	52.3 (87)	51.8 (85)	71.8 (17)	68.0 (20)	—	—
» » »	XI	24. July.....	—	—	68.9 (20)	70.7 (24)	76.4 (14)	80.1 (12)
» » »	VI	10.—11. June...	51.1 (62)	52.0 (60)	—	64.4 (16)	—	—
Lille Hellef. Bank....	XII	14. July—3. Aug.	51.6 (117)	51.8 (86)	67.4 (36)	68.2 (37)	77.8 (13)	79.3 (22)
Fylla Bank.....	XIII	21. July & 4. Aug.	54.1 (48)	55.8 (55)	69.5 (66)	69.7 (61)	78.8 (6)	79.3 (8)
Fiskenes Bank.....	XIV	10. Aug.....	55.2 (16)	54.6 (23)	69.2 (17)	72.1 (27)	75.8 (12)	—
Dana Bank.....	XV	11. Aug.....	—	—	70.8 (13)	71.3 (10)	—	—
Amerdlok Fjord.....	V	6. July.....	51.7 (52)	52.1 (49)	62.8 (10)	63.3 (11)	—	—
Godthåb Fjord.....	VIII	30. Apr.—7. May	43.8 (13)	46.3 (9)	61.5 (8)	68.1 (15)	65.2 (9)	71.1 (8)
Ameralik.....	IX	13. May.....	56.4 (23)	55.8 (17)	67.5 (29)	69.7 (36)	76.1 (18)	77.6 (14)
Julianehåb.....	—	—	—	—	64.7 (23)	65.8 (26)	75.2 (11)	75.6 (10)

Mean lengths calculated from material for the years 1931—39.

	V-Group		VII-Group		X-Group	
Northern ¹⁾ districts	62.1	62.1	72.0	74.2	83.3	86.7
Southern ²⁾ districts	59.7	59.6	72.1	73.0	78.6	80.5

¹⁾ Material collected north of 62° N.L. ²⁾ Material collected south of 62° N.L.

they disappear with the capelin from the fjord and migrate to coastal waters and the offshore banks.

From a tagging experiment carried out in Ameralik Fjord in May 1952 seven recaptures have hitherto been recorded, i.e., four from coastal waters, one from Fylla Bank and one from Store Hellefiske Bank.

The two samples from Julianehåb district (XVIII and XIX) differ from the other samples south of 69° N.L. by the absence of the 1947 year-class. The 1945 year-class is the richest in the samples from this district. It is also remarkable that in one of the samples (XIX) the 1942 year-class amounts to a little more than 20%.

3. Length measurements of cod.

In Figure 33 are given length distributions in 5 cm. groups of cod from samples taken on the offshore banks and from two samples from coastal waters. The roman numerals correspond with those given on the map (Fig. 32). The material consists mainly of measurements of tagged cod and of cod from which otoliths are taken. Some of the graphs are based upon a rather small number of measurements. Nevertheless the peaks of the graphs correspond fairly well with the occurrence of the different dominating classes in the samples.

4. The growth-rate.

In Table 16 are given the mean lengths of both sexes of cod belonging to the three year-

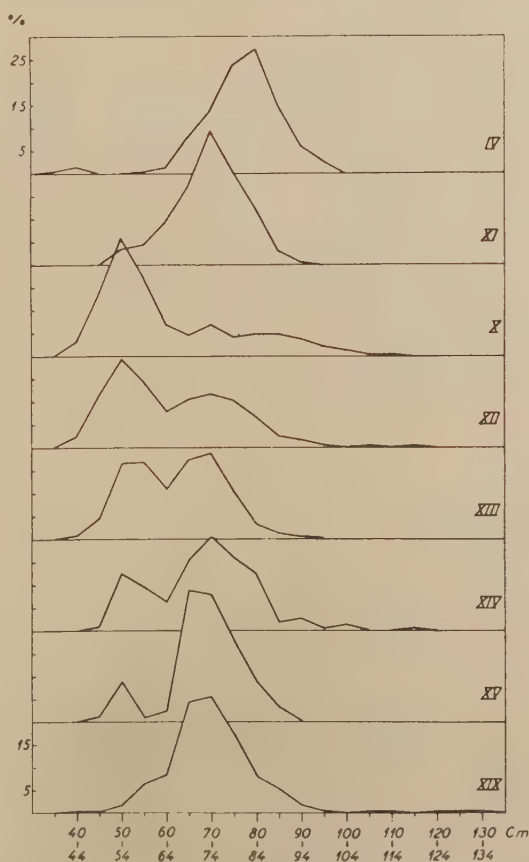


Figure 33. Length distribution.

classes 1947, 1945, and 1942 from catches taken at twelve different localities off West Greenland in 1952 including samples from offshore banks, coastal waters and the fjords. In the same table are also given the mean lengths of five-, seven-, and ten-year-old cod calculated from a large material taken in the years 1931 to 1939. It is clearly seen that the mean lengths in 1952 are much lower than those found in the period 1931—39, and they thus indicate a slower growth-rate. The mean lengths for cod belonging to the 1947 year-class are about the same in 1952 as those found for four-year-old cod in 1931—39. It is obvious that this very slow growth-rate affects the output of the fishery to a very high degree. The slow growth-rate may probably be ascribed to an overpopulation of cod in the area or scarcity of food or some other environmental factor (climatic change?). The very low growth-rate for cod from the Godthåb Fjord is remarkable.

5. Tagging experiments with cod.

A total of 1545 cod were tagged on the offshore banks on board the "Dana" in 1952. The localities where tagging experiments were carried out coincide with the stations where otolith samples were taken. On the map these stations are IV (121), VI (128), X (258), XI (139), XII (525), XIII (101), XV (50).

In coastal waters and in fjords 2234 cod were tagged on board the "Adolf Jensen". The stations were: V (397), VIII (103), IX (337) and XIX (1397).

153 recaptures were taken in 1952. 142 were taken in Greenland waters while 11 were taken at Iceland. The distribution by years of tagging is as follows:—

Recaptures in 1952	Years of tagging						Total 1952 number recapt.
	1946	1947	1948	1949	1950	1951	
Greenland .	1	—	15	13	11	28	74
Iceland. . .	—	—	2	2	1	6	11

Eleven recaptures from Iceland is a little higher than the numbers of recaptures in that area in the years after the war but nothing compared with the numbers of recaptures taken in the years before the war in the Icelandic area. In 1939 for instance 66 recaptures were made at Iceland while 64 were recorded at Greenland. In 1931 the numbers were 47 at Iceland and 32 at Greenland; in 1933, 57 at Iceland and 22 at Greenland; and in 1934, 55 at Iceland and 48 at Greenland.

From eight of the eleven cod taken at Iceland in 1952 otoliths were received. These eight cod belonged to the following year-classes:—

Year-class.....	1938	1942	1943	1945
No. of cod.....	1	4	1	2

The most interesting recapture was taken by an Icelandic trawler on Store Hellefiske Bank on 30. August. Only the tag (small Lea tag) was found, unattached and lying on the deck. The cod was marked on 6. August 1949 in Umanak, 70°39'N., 52°00'W. and was only 20 cm. long when tagged. Doubtlessly it belonged to the year-class 1947. In 1949 about 1000 small cod were tagged with Lea tags in Disko Bay and Umanak Fjord, where very large shoals of small cod, mainly belonging to the 1947 year-class, were concentrated. In 1951 two recaptures of these cod tagged in North Greenland were taken in the coastal waters off South Greenland in Amerdlok Fjord 66°52'N., 52°52'W. and at Narssak near Godthåb 63°50'N., 51°38'W. The cod were marked at Ritenbenk 69°43'N., 51°20'W. 27. July and at Christianshåb 68°50'N., 51°10'W. 26. August. They were taken in distances from the marking place of 210 miles and 360 miles respectively. The lengths were 42 and 33 cm. at the time of tagging and they belonged to the year-classes 1943 and 1945 — but lengths at recapture are not reliable. It appears from the experiments that a migration of small cod takes place to South Greenland from North Greenland waters. It is possible that there was a very intensive migration of small cod of the year-class 1947 in 1952 from North to South Greenland coastal waters and to the offshore banks which explains the enormous occurrence of the 1947 year-class especially on the northern banks. The absence of this year-class in the sample XI seems to indicate that these small cod are distributed only over the more shallow parts of the banks near the coast and not over the deeper water on the western slopes of the banks.

P. M. HANSEN.

Norwegian Fishery Investigations in 1952.

During the summer of 1952 Mr. LEIF ØYEN ERICHSEN went to West Greenland waters to collect material for the Institute of Marine Research. He worked on board the commercial

ong-liner "Havmann" which left the port of Færingehavn for the fishing grounds on 7. August.

The fishery and sea temperatures.

During the first half of August most Norwegian vessels obtained only poor catches on all the banks with their bottom long-lines. In early August the Norwegian fleet was mainly fishing the northern grounds from the Disko Bank southwards to the northern edge of Lille Hellefiske Bank. The majority of the vessels had gathered on the Holsteinsborg Deep, situated between Store Hellefiske Bank and Lille Hellefiske Bank, where a fishery with pelagic long-lines was carried out. In this locality shoals of cod were shoaling in the upper strata of the sea in depths between 20 and 90 m. with greatest concentration at 40—60 m. The surface temperature here was about 4° C. decreasing to 2.3° C. at a depth of 90 m. From the depth of 100 metres to the bottom (210 m.) the temperatures were 1.3—1.0° C.

"Havmann" was fishing with pelagic long-lines on the Holsteinsborg Deep during the period 8.—16. August. Altogether 25 skates of long-lines were hauled, the long-lines being held in position in depths of 25—75 m. by means of buoys. One skate of the pelagic gear usually contained 5000 hooks. While fishing in this area the observer worked 8 hydrographic stations with bathythermograph and 6 stations with Nansen reversing thermometers. In Table 17 appears the yield of the fishery in relation to the temperatures observed. The temperatures are as far as possible taken at the mean depth of the long-lines, usually at 50 metres.

Table 17.

Temperature °C.....	2.1—2.5	2.6—3.0	3.1—3.5	3.6—4.0	Total/ Mean
1000 hooks .	2	20	43	40	105
No. of cod per 1000 hooks .	35.0	90.0	150.3	150.8	134.6

The figures in the table indicate that upon leaving the bottom and entering the upper strata of the sea the cod seem to prefer considerably higher temperatures than those usually found near the bottom. During the pelagic shoaling the greatest concentrations of fish are found in temperatures between 3 and 4° C. Also the temperature interval 2.5—3.0° C. seems to offer a satisfactory habitat. At lower temperatures the density of cod was found to be

rather small. Large shoals of cod were at times observed shoaling near the surface, and catches made by hand-lines indicated the presence of large numbers of fish in depths of 20—40 m.

The fact that the cod, at a certain period during the summer, often seek a pelagic existence may, not only, be due to the temperature conditions but may also be induced by the rich occurrence of food organisms in the warm upper layers. An examination of the stomach content of the cod proved that at this period they were feeding largely on pelagic organisms, particularly euphausiids, pteropods, fish larvae, sandeels, octopus and small jellyfish.

The shoals of pelagic cod gradually thinned out, and by 20. August most of the fishing vessels had resumed their fishery with bottom lines. From now on, until the end of the season the "Havmann" was fishing together with other Norwegian long-liners in the area near Disko. The "Havmann" made two trips to that area, one during 17.—30. August, the second during 8.—29. September. The fishery was carried out with bottom long-lines in depths from 35 to 370 m. Temperature conditions were noted by means of a bathythermograph (40 stations) and reversing thermometers (18 stations).

The catches made at various temperatures are shown in Table 18. Where temperature readings at both ends of the long-line are at hand the mean value of the two readings have been used. In cases where bottom temperatures are lacking we have used observations taken near by on the same day. With the changes in bottom temperatures often encountered on the northern banks such a procedure may of course give room for some error.

Table 18.

Temperature ° C.	No. of 1000 hooks	No. of cod per 1000 hooks
0.6—1.0....	48	78.4
1.1—1.5....	96	70.3
1.6—2.0....	113.5	84.6
2.1—2.5....	151.5	100.8
2.6—3.0....	23	86.8
3.1—3.5....	10	91.8
3.6—4.0....	8	84.5
4.1—4.5....	10.5	74.3
Total/Mean .	466.5	86.2

Catches above average are made at temperatures between 2.1 and 3.5° C., the largest quantities being taken at the interval 2.1—2.5° C. In bottom water below 1.5° C. or above 4.0° C. the occurrence of cod is apparently less

dense. The food organisms consumed by the cod roaming over the bottom have a different character than those of the pelagic cod previously mentioned. In the stomach contents of the bottom fish the deep sea prawn particularly dominates, but also crabs, amphipods, fish and sea cucumbers form part of the food.

From the material at hand we may also gain a picture of the temperature situation, in general, on the Disko Bank area in September. Above the shallow part of the bank, where the depths are less than 100 m., the sea was clearly stratified. The surface temperatures were generally 4–5° C., at 50–60 m. there was a sharply defined transition layer where the temperature dropped from 4 to 2° C. In some places the transition layer touched the bottom, and here the cod seemed to be concentrated in larger numbers. In other places the bank was covered with water of temperatures below 1° C., and here the fishery mostly gave poor results. On the southern slope of the Disko Bank a thin surface layer with temperatures above 5° C. was found. Between 30 and 100 m. the temperature range was 2.5–2.0° C., and the bottom temperature at 150–180 m. about 1.7° C. In this northern area no pelagic shoals of cod were observed.

Intensity and yield of fishery.

In 1952 the majority of the Norwegian long-liners started their fishery off West Greenland in early June. Faroese vessels were reported to have fished very well with long-lines on Fiske-næs Bank and Banan Bank in May. In June the line-caught cod were rather small-sized and

Table 19.

Locality	8.–30. August		7.–29. September	
	No. of 1000 hooks	No. of cod per 1000 hooks	No. of 1000 hooks	No. of cod per 1000 hooks
Holsteinsb. Deep.	105	135	—	—
St. Hellefiske Bk.	23.5	79	—	—
Disko Deep	60	114	16	86
S. Disko Bank . . .	31	79	—	—
W. Disko Bank . . .	56	92	96	58
N. Disko Bank . . .	—	—	192	85
Total	275.5	110	304	77

in poor condition. From early July to the end of the season the Norwegian vessels were mostly engaged in fishing on the northern banks where the cod were larger and the condition of the fish steadily improving.

Vessels fishing out from ports in Norway generally make two trips to Greenland waters, while those fishing from the base at Færingehavn make 4–5 trips on the banks. The long-line fishery is carried on with great intensity. A single skate of long-lines carries 3–5,000 hooks and stretches over 3–5 miles of ground. Ordinarily 4–5 skates, or 16–20,000 hooks are fished every day.

To indicate the yield of the fishery at different temperatures the term “catch per 1000 hooks” has been used. It seems natural to use the same term as a unit of effort in discussing the yield of the fishery in the various localities and at different periods. In Table 19 the catches per unit of effort on the last two trips made by the “Havmann” are shown.

Table 20.

Age, years	Holsteinsborg Deep		St. Hellefiske Bank		Disko Deep		South Disko Bank		West Disko Bank		Mean	
	%	cm.	%	cm.	%	cm.	%	cm.	%	cm.	%	cm.
5	0.5	53.0	—	—	0.3	52.0	1.4	47.5	—	—	0.5	50.6
6	0.9	59.0	—	—	1.9	62.7	2.0	60.0	0.8	60.0	1.3	60.9
7	8.3	69.4	—	—	6.0	67.3	4.8	63.3	3.3	66.0	6.2	67.9
8	4.6	72.4	10.0	69.5	5.7	69.7	2.0	74.0	2.5	75.0	4.5	71.5
9	9.4	72.8	12.5	70.0	13.3	71.9	17.0	73.3	14.0	72.4	12.3	72.4
10	37.2	75.9	35.0	74.8	46.5	75.2	26.6	77.6	33.0	76.4	38.0	75.8
11	8.3	77.1	5.0	85.0	8.9	77.9	13.0	81.4	13.2	78.8	9.5	78.5
12	7.1	78.7	—	—	6.2	78.8	4.8	82.9	7.4	82.6	6.2	79.7
13	4.6	78.9	12.5	76.2	3.5	81.5	8.2	83.1	6.6	83.5	5.3	80.8
14	—	—	—	—	—	—	—	—	—	—	—	—
15	2.3	80.5	2.5	72.0	0.6	78.5	1.4	84.0	0.8	83.0	1.6	80.3
16	10.3	83.1	15.0	85.7	3.8	83.6	8.2	84.3	5.8	84.7	7.8	83.7
17	1.6	84.7	—	—	1.0	88.3	2.0	84.3	1.7	86.5	1.4	85.6
18	4.7	85.9	5.0	87.0	2.9	85.0	8.8	89.1	9.1	89.1	5.2	87.3
19	—	—	2.5	137.0	—	—	—	—	0.8	100.0	0.2	118.5
20	—	—	—	—	—	—	0.7	90.0	0.8	85.0	0.2	87.5
21	—	—	—	—	—	—	0.7	98.0	—	—	0.1	98.0
No. of Cod	435	—	40	—	315	—	147	—	121	—	1058	—
Av. length	—	76.4	—	76.2	—	75.1	—	78.5	—	78.6	—	76.6

In August the best yield per unit of effort was obtained during the pelagic long-lining in the Holsteinsborg Deep. Here the daily catch of the vessel averages 2700 fish using 20,000 hooks. Disregarding the pelagic fishery, the yield on bottom lines averages 95 cod per 1000 hooks, or 1520—1900 cod during an average day's fishing.

In September the yield of the long-line fishery shows a decreasing tendency. The average catch per day's fishing is between 1230 and 1540 cod. However, the fish caught on the last trip were large and fat which could still make the fishery remunerative. During the second trip a total of 23,265 cod were caught which yielded 40 tons of cured fish. If we apply the conversion factors used in Norway (cured weight + 70% gives gutted weight; the latter + 40% gives round fresh weight) the mean weight of the freshly caught cod should be 4.1 kg. This figure, however, seems somewhat too high. The question of a correct conversion factor for Greenland cod will be more closely examined during next year's fishery.

Size and age of line-caught cod.

From the northern banks a total of 2500 otoliths and length measurements were collected. At present, however, only about half the age material has been read. The age composition and the mean lengths of the different age-groups found among the line-caught cod are listed in Table 20.

From the table it can be seen that large and old fish still can be found on the northern banks. The tendency of the old fish to gather on the northern banks has also been noted in previous years. In 1952 we find a distinct division with regard to the mean age of the fish on Disko Bank and cod caught further south. The mean age of the Disko cod is 11.5 years. In the Disko Deep the figure is 10.3, at Holsteinsborg Deep 11.1 years. A corresponding difference is also found in the mean size of the fish. The cod from Disko Bank have a mean length of 78.5 cm., those from other localities about 76 cm.

In Figure 34 the age composition of line-caught cod in the years 1948—1952 is illustrated. In 1948 the two year-classes, 1934 and 1936 dominated the fishery. These cod were by then 14 and 12 years of age respectively. In the subsequent years these two year-classes decrease in strength. In 1952, when the same fish are 18 and 16 years old respectively, they are,

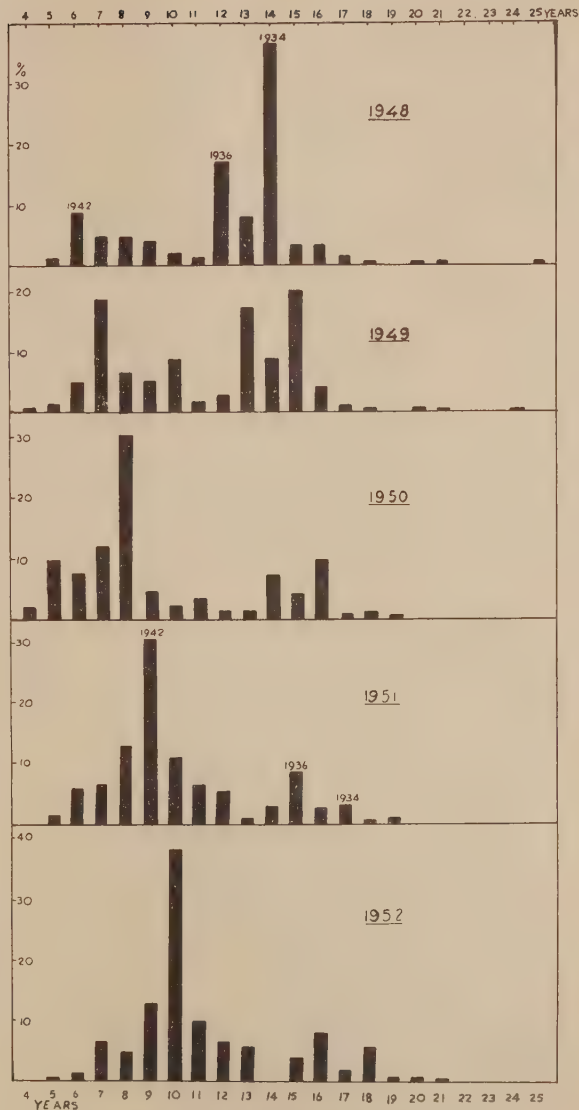


Figure 34. Age composition of line-caught cod, Norwegian vessels, West Greenland banks, 1948—1952.

however, still able to contribute materially to the fishery. Of particular interest is the fact that the pelagic cod from Holsteinsborg contained a total of 15% of these year-classes. In last year's report it was mentioned that the Holsteinsborg cod differed from the ordinary bank cod in their general appearance. It was this particular type of fish which also made up the pelagic catches in 1952.

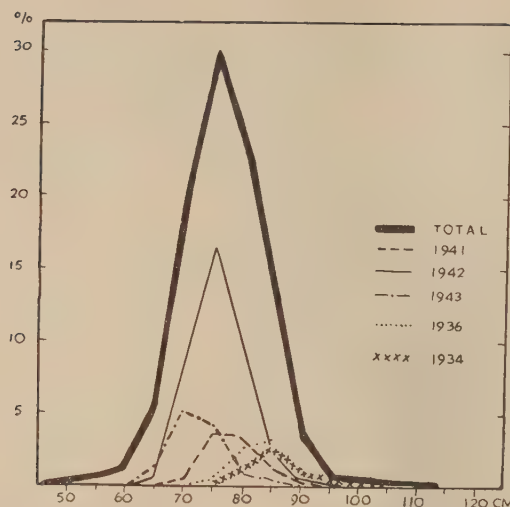


Figure 35. Size distribution of various year-classes of cod, caught on long-lines by Norwegian vessels, West Greenland banks, 1952.

Figure 34 further shows that it is the 1942 year-class which has dominated in the line catches during the last years. In 1951 this year-class contributed 31% to the total catch. In 1952 its contribution increases to 38%. Thus it is still the 1942-class which is, more than ever, the main support of the line fishery.

Figure 35 shows the size distribution of the line-caught fish, both totally and for the most important year-classes. It is the solid strength of the 1942 year-class which chiefly determines the total mean size of the line-caught fish. The five year-classes shown in the figure, viz., 1941, 1942, 1943, 1934, and 1936 constitute altogether 72.8 % of the catch in 1952.

The total Norwegian catch at Greenland in 1952 was approximately 9,400 tons of cured cod, or 22,400 tons of cod in fresh round weight. This corresponds to a catch of about 5.5 million cod. Of these numbers, the 1942-class is responsible for 2.1 million cod.

In last year's report, mention was made of the 1947 year-class. This brood was deemed to be unusually rich and is expected to give a high yield in the future. This year-class is, by now, 5 years old, but the fish have not yet reached such a size that they readily take the hooks. In two years, from 1950 to 1952, this brood has grown from 30 to 51 cm. With a similar rate of growth the 1947-class can be expected to enter the catches to a higher degree by 1953.

BIRGER RASMUSSEN.

Analysis of Trawl-Caught Cod in Greenland Waters in 1952.

The material.

In 1951 Icelandic trawlers commenced fishing in Greenland waters and in 1952 29 trawlers made 72 trips to the banks off the west coast during the months May to November.

On one of these trawlers, "Petur Halldórsson" RE-207 from Reykjavik, stud. mag. INGVAR HALLGRIMSSON, secured the following material of cod during a trip which lasted from 3. Sept. to 17. October.

		Otoliths	Length measur.
Holsteinsborg.....	8.—9. September	519	354
Store			
Hellefiske Bank...	10.—20. —	3383	2,906
Fylla Bank.....	22. Sept.—12. Oct.	1038	11,581
Total.....	8. Sept.—12. Oct.	4940	14,841

A total of 19,781 cod were examined and of these nearly five thousand otoliths were taken. The actual catch of the trawler was 3398 boxes of split cod (the weight of each box 140 kg., the average number of fish per box on this trip was 88.6). The number of salted cod thus amounts to 301,063. To this we have to add the fish under 48 cm. which were discarded for salting and converted to fish meal. According to the length measurements 6.1% or 20,013 fish belonged to these size categories. Thus the total catch of cod amounts to 321,076. The percentage of the total catch sampled is 6.2% but varies somewhat for the different banks. Therefore the average age- and length-distributions are weighted in accordance with the actual size of the samples.

2. The age composition and length distribution.

Table 21 shows the age composition for the different banks together with the average lengths of the age-groups. The average age distribution for all the samples unweighted and weighted is also given. The results of the table are shown graphically in Figure 36. The two year-classes 1945 and 1947 make 78.2% of the total catch. 50.7% belong to the 1947 year-class and 27.5% to the 1945 year-class.

If we also include the 1946 year-class these three made 86.9% of the total catch. The absence of the older year-classes is very striking. According to RASMUSSEN (Praktiske fiskeforsøk 1951) the 1942 year-class dominated in the Norwegian long-line catches on these banks in 1950 and 1951 (over 30%). In PAUL M.

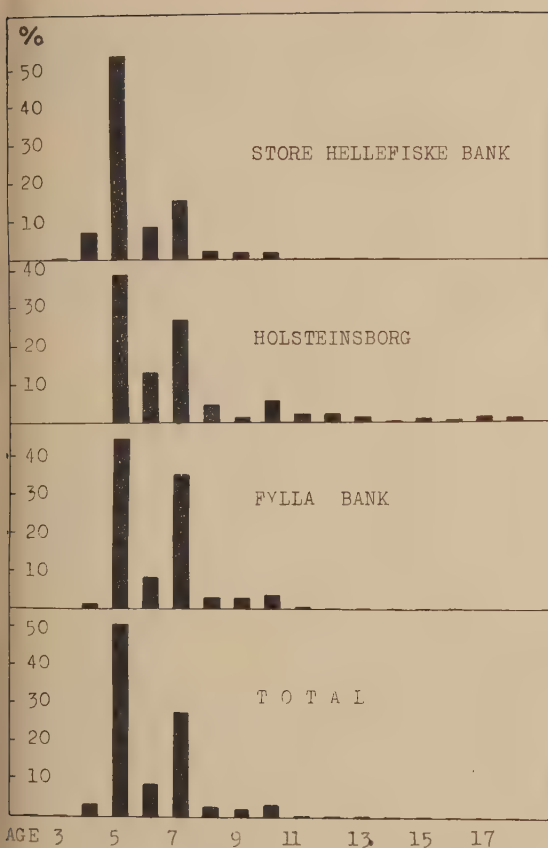


Figure 36. Age distribution of cod on different West Greenland fishing grounds.

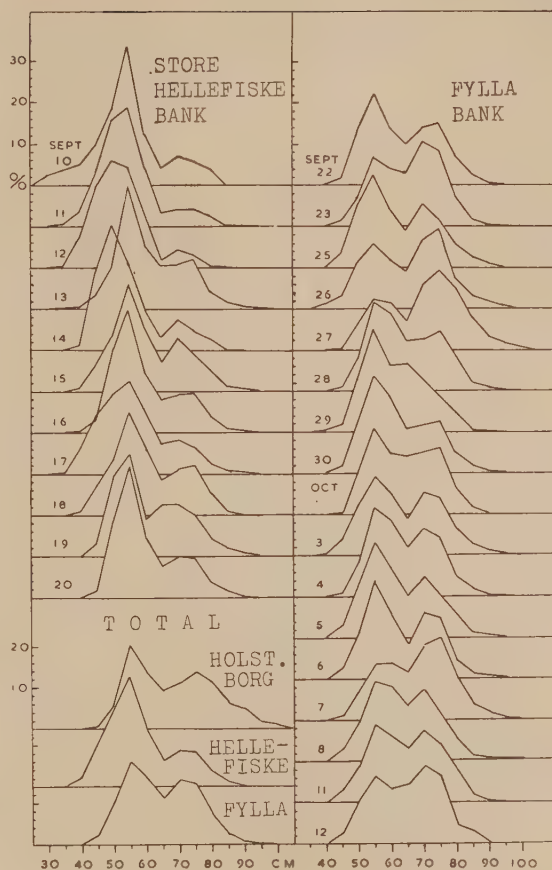


Figure 37. Size distribution of cod.

Table 21. Age Composition on the different Banks and the Average Lengths of the Age-Groups.

Age (Years)	Store Hellefiske- bank		Holsteins- borg		Fylla- bank		Total (unweighted)		Total (weighted)
	%	cm.	%	cm.	%	cm.	%	cm.	%
2.....	0.2	32.0	—	—	—	—	0.1	32.0	0.1
3.....	0.3	35.8	—	—	—	—	0.2	35.8	0.1
4.....	6.9	43.5	—	—	1.3	47.1	4.2	43.9	3.2
5.....	63.3	52.6	38.6	55.8	44.5	54.9	54.1	53.5	50.7
6.....	8.4	60.3	13.0	63.0	8.3	63.3	8.7	61.7	8.7
7.....	15.4	70.8	26.9	72.1	35.3	71.8	24.0	71.5	27.5
8.....	2.0	73.0	4.5	77.7	2.9	76.2	2.5	75.0	2.7
9.....	1.5	74.6	1.3	73.0	2.9	75.9	2.0	75.2	2.2
10.....	1.5	77.4	5.8	78.8	3.7	79.7	2.7	78.8	3.1
11.....	0.1	74.0	2.2	83.4	0.5	81.2	0.4	81.6	0.5
12.....	0.2	79.7	2.2	90.2	0.1	80.0	0.3	85.6	0.3
13.....	0.1	86.0	1.3	90.3	0.1	106.0	0.2	92.6	0.2
14.....	0.1	88.0	0.4	91.0	0.1	96.0	0.1	91.7	0.1
15.....	—	—	0.9	87.0	0.1	89.0	0.1	87.7	0.1
16.....	—	—	0.4	87.0	0.3	87.3	0.1	87.3	0.2
17.....	—	—	0.3	95.0	—	—	0.1	95.0	0.1
18.....	—	—	0.9	91.0	0.1	97.0	0.1	93.0	0.1
Total.....	1506		223		1084		2813		

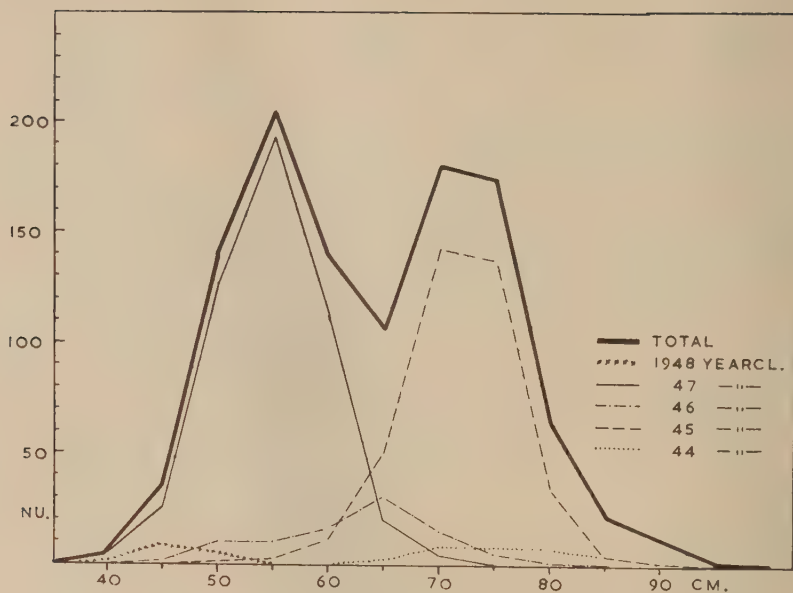


Figure 38. Size distribution of the different year-classes of cod.

HANSEN's material, taken in 1950, this year-class dominated in all the districts sampled, but he is expecting the 1947 year-class to be of great importance in the coming years, as it has been found in great quantities all along the coast. He considers this to be the biggest year-class which has occurred in the stock in recent years (Fangst og Fiske no. 7—8, 1951). In our material this year-class is of no importance (3.1%).

The uniformity of the catches from day to day is very clear. Extensive length measurements were made almost every fishing-day and the daily length distributions are shown in Figure 37. All the curves have the same bimodal shape. That these peaks represent the year-classes 1947 and 1945 is evident from Figure 38, where the curve showing the length distribution of the age-determined fish has been split into the various age-groups. Closer examination of Figure 37 shows that there are daily fluctuations in the proportion of the two dominating year-classes. On Store Hellefiske Bank the dominance of the 1947 year-class is more constant, whereas on Fylla Bank this dominance is not so apparent. The average lengths on Fylla Bank are for the 1947 year-class 54.9 cm. and for the 1945 year-class 71.8 cm. and these lengths coincide with the two maxima in the length distribution. The proportion of the percentages of seven- to five-year-old fish is

35.3 : 44.5 = 0.79 and if we take in the same way the proportion of the length groups 70 to 55 cm. we get exactly the same value 157 : 199 = 0.79. Without great error we can therefore compute the proportion of these two year-classes as the proportion of the 70 to the 55 cm.-groups.

For Fylla Bank we then see that during 22.—27. September there is a dominance of the 1945 year-class in 3 days out of 5, but according to the actual catches the ratio is 7/5 or 0.91. From 28. September to 6. October there is a clear dominance of the 1947 year-class, and the ratio is 0.64. Lastly from 7.—12. October there is a dominance of the 1945 year-class in 2 days out of 4, and the ratio is 1.01.

3. The growth.

The growth of the Greenland cod is very slow compared with the growth in Icelandic waters. The following figures give the average length (and weight) of the 1947 year-class on the Greenland Banks, Skjálfandi Bay (north Iceland) and Faxa Bay (south-west Iceland) in 1952.

Locality	Date	Length cm.	Weight kg.
Greenland.....	8.—26. Sept.	53.5	1.5
Skjálfandi Bay...	19. May	61.6	2.1
Faxa Bay.....	24. May	81.3	4.2

The cod from Faxe Bay are 2.8 times heavier than the Greenland cod. This difference is greater than normal and must largely be due to overcrowding in the Greenland waters.

4. The catch per unit of effort.

Table 22 shows the number of fish caught on the different banks and the catch per unit of effort. The bottom temperatures on these banks are also given.

Table 22.

	No. of fish caught	Hours fished	No. of fish per hour	Year-class per hour 1947 1945	Bottom temp. °C.
Holsteinsborg	25,687	22	1168	451 314	4.1 —4.3
St. Hellef. Bk.	125,962	143	881	558 136	3.65—4.55
Fylla Bank..	156,886	196	800	356 282	2.00—2.45
Dana Bank..	12,541	9	1393	— —	—
Total...	321,076	370	868	440 238	—

The trawler spent 36 days (864 hours) on the fishing grounds. The actual fishing time was 370 hours or 42.8%. The richest catches were taken on rough bottoms and therefore the figures for actual fishing time are somewhat lower than usual (time spent for repair etc.).

The catch of split cod was 475.7 tons and makes 621 tons gutted with their heads (according to the Icelandic conversion figures). This gives 167.8 tons per 100 hours or 17.3 tons per "day's fishing".

In 1950 the catch per "day's fishing" of Icelandic trawlers fishing (cured fish) on Icelandic grounds was 17.1 tons for the period January—December.

JÓN JÓNSSON.

German Cod Investigations.

Observations made in June 1952 on board the first two German trawlers to operate on the banks of the west coast gave, fairly generally, length curves with two peaks, at about 50 and 65—70 cm., corresponding to the average length of the two year-classes 1947 and 1945 which were by far the strongest. The first peak was dominant only on Fylla Bank and was almost absent on Dana Bank, the most southerly ground fished, where only few young fish (about 30 cm.) were caught. In the correspond-

ing commercial catches small fish below 55—60 cm. were hardly represented, this size not yet being marketable.

The catch per hour's fishing in June was as follows:—

Fishing ground	Total catch		Marketable fish	
	Number	Baskets (cwt.)	Number	Baskets (cwt.)
SW. off Frederikshaab	381	17	300	15
Dana Bank.....	1313	56	1093	54
Fiskenæs Bank.....	5423	202	3742	173
Fylla Bank.....	2660	73	1251	47
Ll. Hellefiske Bank...	1988	68	1285	57

The observations on the market a month later showed that the absolute number of larger fish—calculated as catch per voyage—had fallen to about 25%. Now, the peak of the small fish proved to be the higher one in the commercial catches also, which means that for want of large fish a much greater number of small ones had been landed. It cannot, however, be decided whether the absolute density in the area had increased or decreased, since the numbers which appear on the market depend upon the keenness of the selection. At any rate the decrease was slighter in smaller than in larger fish.

On the Cape Farewell ground, where German trawlers have fished since 24. 9. 52 until about

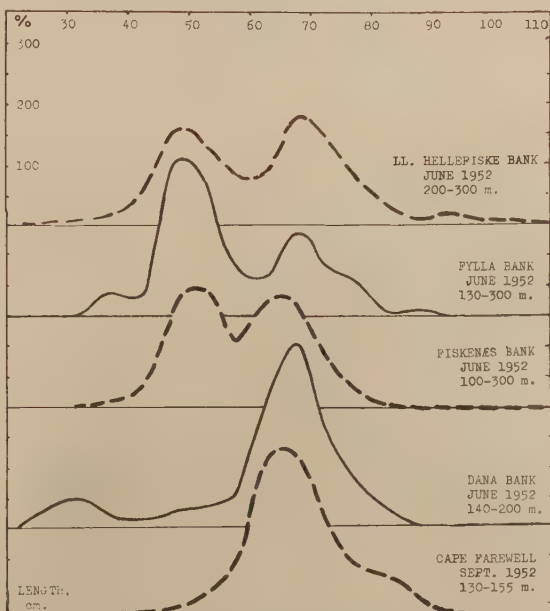


Figure 39. Length composition of the cod catches taken by German trawlers at Greenland.

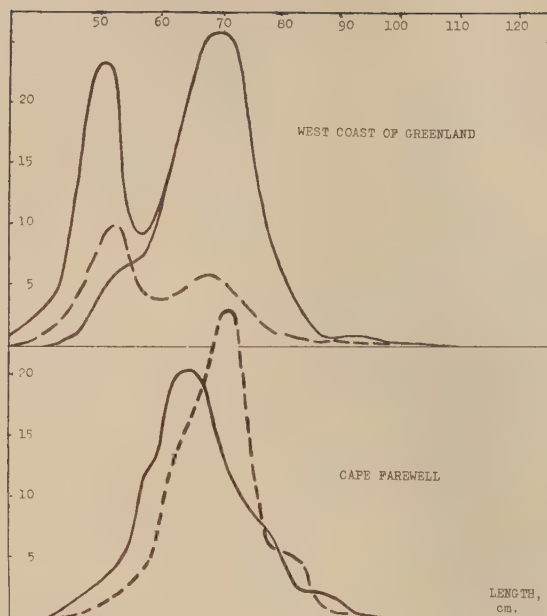


Figure 40. Length composition of the German cod landings at Greenland.

Top, West coast of Greenland.

June 1952: 96,000 fish = 220,000 kg.

(Left-hand curve, undersized fish)

----- July 1952: 39,000 fish = 70,000 kg.

Bottom, Cape Farewell.

—— September—October 1952: 83,000 fish = 200,000 kg.

----- January 1953: 78,000 fish = 200,000 kg.

the end of January 1953, the cod constituted 99% of the catches—they were almost exclusively large and mature fish mostly before their first spawning. The percentage of cod below 50 cm. was far less than 1% of the total catch. Thus the curve of the market landings corresponds to that of the total catch. The peak of the length curve was at the end of September 1952 at 65 cm. and in January 1953 at 71 cm. (a result of the length increment?). The bulk of the catch, 662‰, was sustained by the 1945 year-class. The 1942 year-class has still a certain commercial value. The catches per day (good catches at day-time and bad at night) at Cape Farewell during 26. 9.—3. 10. 1952 fluctuated between 75 and 795 baskets. 6—66 baskets per hour's trawling were taken, at an average of 30 baskets.

In June, the cod on the Fiskenes Bank had taken hardly any food; of 35 stomachs 30 were

Table 23. Age Composition of Cod Catches, in ‰.

Age-group	Year-class	W. Greenland			Age-group	Year-class	Cape Farewell ²⁾
		June 1952 ¹⁾	Net catches	Market landing			
I	1951	—	—	0	XII	1940	16
II	1950	0	—	0	XIII	1939	3
III	1949	14	—	1	XIV	1938	1
IV	1948	26	1	3	XV	1937	5
V	1947	338	167	52	XVI	1936	8
VI	1946	175	175	11	XVII	1935	—
VII	1945	341	490	662	XVIII	1934	7
VIII	1944	51	79	39			
IX	1943	26	40	63			
X	1942	23	39	128			
XI	1941	6	9	1			

¹⁾ 511 scales and otoliths.

²⁾ January 1953. Net catches (= market landings). 496 otoliths.

empty, 5 showed contents of 5—10%; from the observations made while gutting this proved to be the general rule. The stomach content, if any, consisted of offal and parts of gutted fish, in shallow water sometimes also of *Ammodytes* and other fish or echinoderms and the like. On the Lille Hellefiske Bank, however, almost 90% of the cod had a stomach content of generally less than 50% which consisted mostly of euphausiids, *Pandalus*, and *Hyas*, and to a less degree of worms and other bottom animals as well as fish.

In contradistinction to this were the conditions at the end of September on the Cape Farewell fishing ground which is a typical feeding ground. The cod stomachs were always tightly filled up to 90% with capelin (*Mallotus villosus*). Offal, Crustacea (gammarids) and small redfish (25—57 mm.) were also found. Enormous shoals of capelin were constantly being traced by the echograms, and their regular daily vertical movements (concentration and sinking down to the bottom after sunrise, rising and breaking up of the shoals at sunset) could be observed.

The length/weight co-efficient was on an average calculated to 0.87 for the ungutted and 0.82 for the gutted fish; as regards the latter figure the cod of the Bear Island showed an average of 0.72 and that of Iceland, 0.88.

In order to get a general idea of their characteristics the most important proportions of the body were measured in a small number of cod (see Table 24). It would seem as if the Greenland cod, judged by most of the criteria, holds a position between the Icelandic cod, from

Table 24. Mean Body Proportions of 80 Greenland Cod calculated in $\frac{\circ}{100}$ of the total body length.

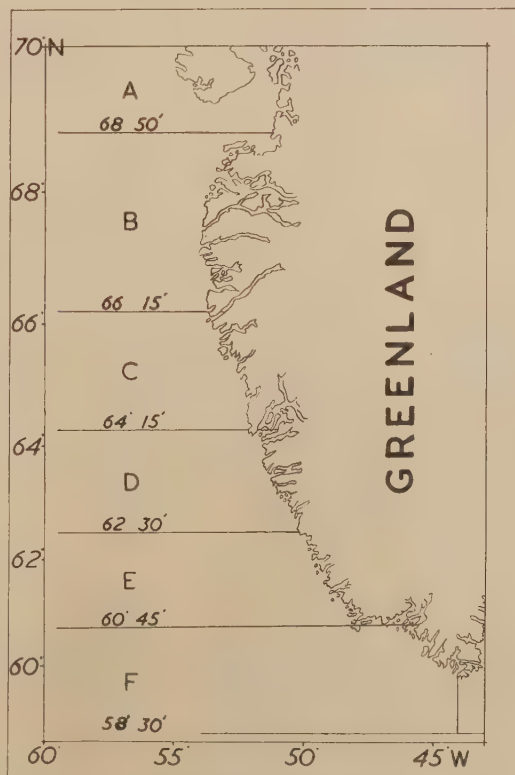
	28—55	Length, cm.		For comparison 60—100 cm.	
		55—85	120—156	North Iceland	Bear Island
Length of snout (to anterior margin of eye).....	73	80	84	77	81
Length of jaw (tip of snout to end of Maxilla).....	85	89	100	103	104
Diameter of eye (vertical).....	49	40	40	42	39
Interorbital space.....	58	62	72	50	54
Depth of head beneath eye.....	60	66	97	59	64
Length of head.....	235	236	253	238	240
Occipital depth of head (posterior margin).....	147	148	174	133	129
Tip of snout to caudal base (in body axis).....	922	923	919	904	926
End of head to caudal base.....	688	687	666	666	686
Predorsal length.....	278	284	313	299	292
Tip of snout to anus.....	429	445	482	—	443
Tip of snout to end of dorsal fin base.....	798	808	806	781	799
Origin of D ₁ to end of D ₃ base.....	520	526	497	482	494
End of D ₃ base to caudal base.....	123	115	113	123	117
Body depth at origin of D ₁	205	212	252	216	195
Body depth over anus.....	166	161	159	—	163
Depth of caudal peduncle.....	43	43	43	45	46
Height of dorsal fins (longest ray).....	113	106	94	108	103
Height of anal fins (longest ray).....	99	93	89	103	95
Length of pectoral fins (longest ray).....	125	124	136	121	120
Length of ventral fins (longest ray).....	112	108	98	115	107
Length of caudal fin (in body axis).....	78	77	81	96	84

which it originates, and those of Bear Island, which it approaches in many respects. The characteristics, which differ from both areas, seem to be following:— a short, high head, short jaw, long spread of the fins, and correspondingly short, and low, caudal peduncle. With some of these characteristics the Greenland cod deviates further from the Icelandic ancestors than the Bear Island cod; it might be assumed that the life in the half-arctic environments exercise its influence. The differences in the variations of the proportions with age are remarkably great, and it might be assumed that the group of older fish—probably born before the mid-thirties—differs in its morphological aspect from the later-born year-classes.

JOHANNES LUNDBECK. ARNO MEYER.

A note on the new English Trawl Fishery at Cape Farewell.

A new English fishery developed on the banks between Cape Farewell and Julianehaab, (Sub-Region F on chart), during the summer and autumn of 1951. The arrival of heavy floe ice terminated the fishery in December 1951. In 1952 regular fishing began in July and persisted, until ice again covered the banks, on 17. January 1953, with the heaviest landings occurring in September and October. It became



Region XV.
Sub-regions of North-West Atlantic Commission.

the most important area for trawled fish in Greenland waters—its total being 27,748 tons for the year.

The "Ernest Holt" visited this area during the period 4.—16. September 1952 and obtained, amongst other observations, length measurements of 1,783 cod, whilst otoliths were collected from a further 403 for age determination and population studies. The bulk of the fish were feeding and were found in water of less than 2° C.

Length frequency curves were remarkably consistent for the four grounds sampled, Kitsigtut, Sermersok, Nanortalik and Cape Farewell, whilst age analysis showed that the 1945 year-class was the dominant year-class in the whole area and represented 61% of the sample. The 1947 year-class, which like the 1945 year-class, has already been appraised as being highly successful on the west coast, was only poorly represented. (Figures 41 and 42.)

The 1945 year-class was composed largely of fish, which, by their otoliths, were first time spawners in the spring of '52, i.e., at 7 years of age, though a small percentage had spawned first in '51. Of the 1947 year-class, it appeared

that a number would be virgin spawners in the spring of the year following capture, i.e., spring '53.

Age composition derived from Hull market samples of fish caught in the last week of December '52, showed little change (Figure 42) had occurred in the shoals at Sermersok and Cape Farewell, though roes had increased in size. They had not, however, reached the stage at which they become valuable commercially.

Mean lengths (in cm.) for the 1947, '46, '45 and '44 year-classes are given below for the two sampling periods, September and December, 1952.

Source	1947	1946	1945	1944
September				
("Ernest Holt")...	51.9	58.7	67.0	73.1
December				
(Market Sample)...	54.8	60.5	69.8	76.1

Because the "Ernest Holt"'s cruise was restricted to the area of Cape Farewell, it was not possible to obtain material which would throw light on the relationship of these shoals to those on the west coast. Dr. PAUL HANSEN very kindly supplied otoliths of cod caught at a comparable time by the "Dana", by line,

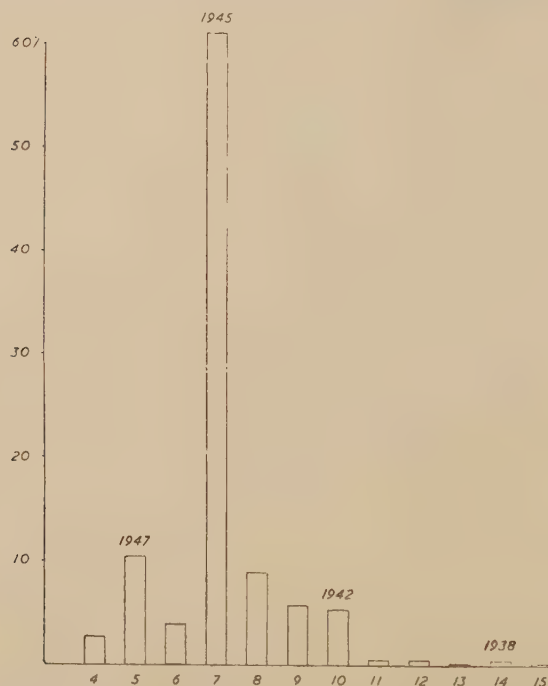


Figure 41. Age composition from "Ernest Holt" samples from Cape Farewell area, September 1952 (403 determinations).

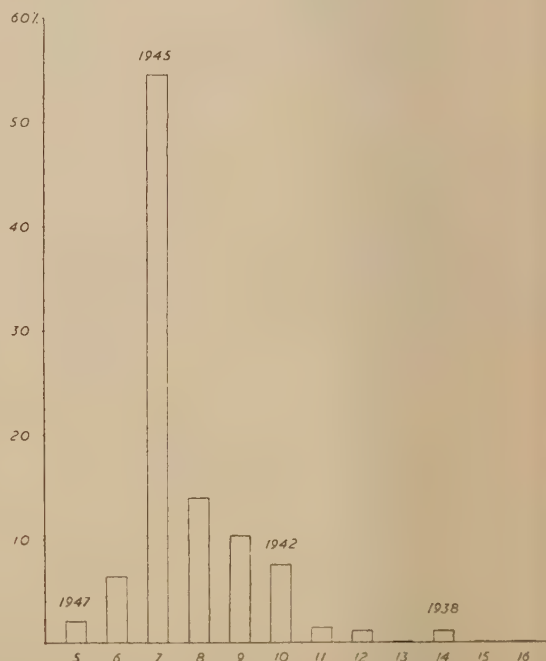


Figure 42. Age composition of market samples of cod from Sermersok and Cape Farewell, December 1952 (305 determinations).

from a position on the Store Hellefiske Bank in the latitude of Holsteinsborg approximately. These otoliths showed a remarkable similarity of growth pattern to those of the "Ernest Holt"'s sample, and the fish are judged to belong to the same population. This observation points to the possibility that the 1947 year-class, virtually absent from the Cape Farewell grounds in 1952, may provide recruits, as virgin spawners, to these southern shoals in the autumn of '53.

Eight recaptures from the release of 256 fish, presumed mature on length data and marked at Cape Farewell in September '52, showed a slight NW. ly movement, of up to 7 miles, within 35 days of their release. No further recaptures have been reported, thus nothing is yet known of the position of the spawning grounds of the Cape Farewell shoals.

Appended is a table of commercial landings from Greenland waters, Region XV, arranged in Sub-Regions according to North-West Atlantic Fisheries Commission.

G. C. TROUT.

English Landings of Cod from Greenland.

Year 1951.

Month	Sub-Regions			
	C Tons	D Tons	E Tons	F Tons
August	—	199	12	—
September . .	—	1,638	230	788
October	—	820	876	3,463
November . .	—	713	698	444
December . . .	—	113	113	477
Total for year	—	3,501	1,929	5,172

Year 1952.

April	—	181	—	—
May	518	940	376	—
June	144	3,537	—	—
July	—	2,806	—	175
August	162	1,344	—	859
September . .	1,434	1,608	—	6,197
October	—	1,472	170	12,222
November . .	—	1,759	—	4,574
December . . .	—	334	—	3,538
Total for year	2,258	13,981	546	27,748

Additional.

1951	February	18 tons	Sub-Region D
1952	February	183 —	— F
1952	July	206 —	— B

Table 25. Length Composition of Redfish Catches from West Greenland in June 1952 (in $\frac{0}{100}$).

cm.	18—20	21—25	26—30	31—35	36—40	41—45	46—50	51—55	56—60	61—65	66—70	70
Bank SW. of Frederikshaab	—	—	207	379	311	103	—	—	—	—	—	—
Fiskenæs Bank	—	—	61	30	121	333	152	61	30	121	61	30
Ll. Hellefiske Bank	6	19	75	139	149	188	207	110	52	52	—	3

Market Landings from West Greenland.

June 1952	—	—	18	86	148	275	264	118	48	38	3	2
July 1952	—	1	70	338	438	108	18	4	10	10	3	0

Redfish.

The percentages of redfish in the catches of the German trawlers were in June about 13%, in July, on account of the failure of cod, about 74%; in the autumn and winter very few redfish only were taken.

The total number caught in June was relatively large; the fish were by far most numerous

in the Lille Hellefiske Bank at a depth of about 300 m. and occurred in much smaller numbers more to the south. The landings in July show very much reduced average sizes, which is undoubtedly due to the fact that, compared with June, a greater percentage of smaller fish had been considered marketable and were landed.

J. LUNDBECK.

Comité Atlantique

INTRODUCTION

De nombreuses et intéressantes contributions des membres suivants du Comité Atlantique et de ses Sous-Comités (Plateau Continental Européen et Plateau Continental Africain) ont été adressées cette année au Président pour leur publication dans les *Annales Biologiques*:

I. Hydrologie.

R. LETACONNOUX.....	France
E. POSTEL.....	Sénégal

II. Plancton et Faune.

E. POSTEL.....	Sénégal
J. H. FRASER.....	Ecosse
J. FLEURY.....	France

III. Poissons.

a) Sardine.

J. LE GALL.....	France
J. FLEURY.....	France
A. RAMALHO et ses collaborateurs...	Portugal
JUAN CUESTA.....	Espagne

b) Germon.

J. LE GALL.....	France
J. LE DANTEC et R. LETACONNOUX..	France
J. FLEURY.....	France

c) Merlu.

B. B. RAE.....	Ecosse
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d) Coquille St-Jacques.

L. FAURE.....	France
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Deux études présentées sur le thon rouge (C. NÉDELEC et E. POSTEL), une sur le merlu blanc (C. MAURIN) et une sur les Sparidés (R. COUPÉ) ne correspondant pas à l'esprit initial de cette édition, paraîtront dans le *Journal du Conseil* (19. 3).

Les observations hydrologiques faites dans le Golfe de Gascogne, principalement dans les

régions où se font les concentrations de sardines, apportent de nouvelles précisions sur les conditions du milieu (température et salinité) où se rassemblent ces bancs, ainsi que les variations annuelles de ces conditions (Pertuis Breton et Pays Basque). Elles confirment l'influence de ces deux facteurs (t° et sal.) sur la distribution de ces bancs et, par suite, sur la pêche.

Les investigations faites au large de Dakar sur le «Climat marin» sont à rapprocher des faciès bionomiques examinés dans le rapport suivant du même auteur: E. POSTEL.

Les éléments dominants de la faune planctonique en Manche, puis au large de la côte N.W. d'Irlande ont été étudiés respectivement par Melle J. FLEURY et J. H. FRASER.

Les recherches sur les Clupéidés des côtes de France, d'Espagne et du Portugal ont donné lieu à trois rapports:

- sur la répartition anormale des concentrations de sardines dans le Golfe de Gascogne en 1952 (J. LE GALL);
- sur la nourriture de cette sardine (J. FLEURY);
- sur la taille et le poids, la maturité sexuelle et la moyenne vertébrale des sardines du Portugal (A. RAMALHO);
- ainsi que sur la pêche de la sardine et de l'anchois dans la région de Santander (JUAN CUESTA).

Les investigations sur les Thonidés ont porté essentiellement sur le germon, sur les conditions de milieu sur les pêcheries (température, salinité et plancton), sur sa pêche et sur la détection ultrasonique des bancs de germons.

Une note préliminaire sur le merlu en Ecosse (B. B. RAE) est venue compléter heureusement les travaux présentés sur ce Gadidé au cours des précédents Colloques.

Le travail de FAURE sur la coquille St-Jacques continue la série des observations faites en Rade de Brest sur la biologie de ce mollusque.

J. LE GALL.

LES CONDITIONS DE MILIEU

Hydrologie.

Observations Hydrologiques Périodiques effectuées dans le Golfe de Gascogne en 1952.

En 1952, le laboratoire de l'Office des Pêches Maritimes à La Rochelle a effectué des observations hydrologiques nombreuses :

1. Dans la région du Pertuis Breton en Janvier, Février, Mars.
2. Entre l'Île d'Yeu et les Îles de Ré et d'Oléron en Mai et en Septembre.
3. Dans la région Basco-Landaise au cours des mois de Février, Avril et Août.

Les observations de la troisième série ont été effectuées en partie par la station d'Arcachon mais les analyses ont été faites, comme celles des deux premières séries, au laboratoire de La Rochelle, selon la méthode de KNUDSEN et avec comparaison avec l'eau normale de Copenhague.

Pertuis Breton.

Les observations effectuées dans le Pertuis Breton complètent celles de l'année 1951. On y remarque la dualité des systèmes qui s'opposent dans cette région :

Eaux salées du large à 32.5-31.5 ‰ de l'entrée nord du Pertuis et accessoirement en Février du coureau de la Pallice.

Eaux peu salées de la Baie de l'Aiguillon poussant en direction nord-ouest mais se heurtant aux eaux à forte salinité et en direction du sud vers le coureau de la Pallice où elles s'étalent plus largement. Près de l'entrée de la Baie de l'Aiguillon ces eaux ont une salinité qui descend jusqu'à 23.5 ‰.

D'après l'ensemble des observations on remarque que les températures sont les plus basses en Janvier (6.9° en moyenne) mais que les salinités au contraire n'atteignent leur valeur moyenne la plus faible qu'en Mars (29.9 ‰).

Ces données concordent avec celles obtenues en 1951.

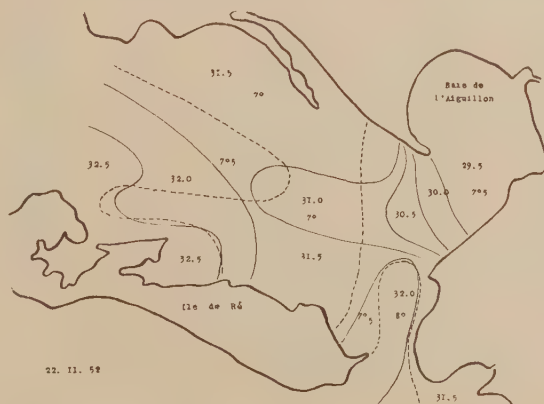


Figure 2.



Figure 1.

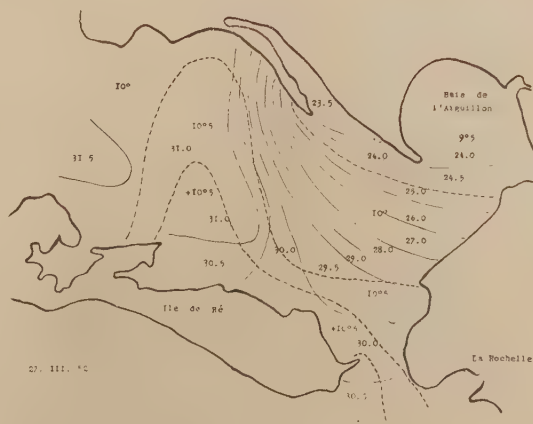


Figure 3.

Figures 1—3. Pertuis Breton, 1^{er} trimestre 1952.
- - - - - t°, ——— S ‰ en surface.

Secteur VIII a. Pertuis Breton.

Navire: Vedette Garde Pêche «Patron Louis Renet».

Observateur: Laboratoire de l'Office des Pêches à La Rochelle.

(AUDOUIN-LETACONNOUX)

St.	Latitude	Longitude	Prof. m.	Date: 25 Janvier		22 Février		27 Mars	
				t°	S ‰	t°	S ‰	t°	S ‰
0	46°08'10	1°14'30	2	7.20	30.95	8.30	31.96	10.45	30.75
1	46°08'35	1°13'15	2	7.10	30.82	7.95	31.96	10.70	30.70
2	46°09'40	1°14'30	2	6.80	30.57	8.25	32.23	10.50	30.43
2			15	8.00	31.73	8.80	33.39	10.90	30.50
3	46°10'45	1°15'30	2	6.40	30.70	7.60	32.12	10.95	30.16
4	46°12'05	1°17'20	2	6.40	30.17	7.45	31.91	10.75	29.85
5	46°12'20	1°18'30	2			7.10	31.82	10.65	30.12
6	46°12'35	1°19'35	2	7.00	31.20	7.15	31.87	10.75	30.44
7	46°13'25	1°20'15	2	6.80	31.06	7.30	32.07	10.60	30.68
8	46°14'40	1°20'25	2	7.60	32.12	7.35	32.07	10.60	31.35
8			10	8.70	32.83				
9	46°14'15	1°22'40	2	7.90	32.77	7.75	32.77	10.80	30.91
10	46°14'45	1°26'20	2	8.00	32.50	7.35	32.52	10.40	31.40
11	46°16'00	1°27'10	2	7.60	32.52	7.75	32.70	10.40	31.51
11			15	8.05	32.86	8.10	33.31		
11			30	8.60	33.15	8.35	33.66	10.65	32.05
12	46°17'35	1°25'35	2	7.00	31.40	7.60	32.01	10.50	31.40
12			10	8.15	32.65	7.55	32.25		
13	46°19'00	1°24'00	2	6.50	30.92	7.45	31.60	10.50	31.26
13			8	7.20	31.44				
14	46°16'50	1°18'10	2	7.40	31.20	7.45	31.80	9.70	23.80
15	46°15'50	1°19'10	2	6.80	30.84	7.70	31.29		
15			10	7.90	32.65				
16	46°15'40	1°14'50	2	7.05	31.17	7.60	31.73		
17	46°15'25	1°11'30	2	5.90	29.05	7.60	29.72	9.95	24.96
18	46°13'55	1°14'30	2	6.30	29.60	7.65	30.90		
19	46°12'15	1°13'40	2	6.60	30.34	8.40	32.34	10.50	29.47
Moyenne des observations en surface:				6.96	31.04	7.63	31.36	10.51	29.95

St.	Latitude	Longitude	Prof.	t°	S ‰
8 Mai					
2	46°09'40	1°14'30	2	14.90	32.54
5	46°12'20	1°18'30	2	14.60	32.29

29 Octobre					
3	46°10'45	1°15'30	2	14.90	32.52
18	46°12'55	1°14'30	2	14.80	32.41

Ile d'Oléron-Pertuis d'Antioche.

Navire: Sardinier «Anne Rose Marie».

Observateur: LETACONNOUX.

St.	Latitude	Longitude	Prof. m.	t°	S ‰
29 Juillet					
1	46°00	1°28	0	14.50	34.97
			10	14.00	35.01
2	46°05	1°22	0		34.85
3	46°05'30	1°17'30	0		34.85

Région entre l'Ile d'Yeu et l'Ile de Ré.

Yacht «Anne Marie Christine».

Observateur: LETACONNOUX.

St.	Heure	Latitude	Longitude	Prof. m.	t°	S ‰
3 Mai						
1	07	46°30	1°48	0	13.60	33.68
2	09	46°35	2°10	0	13.80	33.44
3	11	46°42	2°15	0	13.30	33.78
4	17	46°42	2°07	0		33.75

4 Mai						
5	13	46°37	2°01	0	14.30	33.17
6	16	46°29	1°53	0	13.90	33.35
7	17	46°27	1°57	0	14.30	33.33
8	20	46°25	1°51	0	14.10	33.68
9	21	46°22	1°42	0		33.86
10	22	46°18	1°37	0		33.21

De l'Ile d'Yeu à l'Ile d'Oléron.

Deux sorties ont été effectuées dans ce secteur.

En Mai nous avons observé des salinités qui variaient entre 33.1 et 33.8 ‰ alors que la température en surface était de 13.3 à 14.3°.

Deux régions étaient particulièrement influencées par les eaux du large: le Pont d'Yeu (33.7 ‰) et l'entrée du Pertuis Breton (33.8 ‰).

Au début de Septembre la structure hydrologique en surface est comparable à celle du

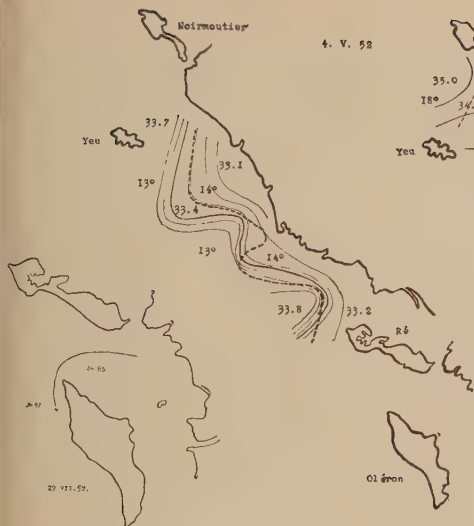


Figure 4.



Figure 5.



Figure 6.

Figure 7
sur le fond.

Figures 4—7. Côtes de Vendée/Charente, 4 Mai, 2 Septembre 1952. ----- t°, — S ‰ en surface;

mois de Mai. On a alors des eaux à 34.8—35.0 ‰ dans la région du Pont d'Yeu et une avancée à 34.8 ‰ dans celle du Pertuis Breton.

Dans la région de l'île d'Oléron au contraire les eaux relativement peu salées qui remontent vers le nord depuis l'embouchure de la Gironde font sentir leur action et l'on observe des salinités de 34.4 ‰ à l'entrée du Pertuis d'Antioche.

En profondeur la situation des masses d'eau est comparable à celle de la surface.

Les températures observées varient de 18.8° à 20.6° en surface et de 17.95° à 20.45° en profondeur les valeurs les plus basses correspondant aux eaux les plus salées.

Région Basco-Landaise.

Dans ce secteur les observations hydrologiques paraissent influencées par deux facteurs géographiques: l'embouchure de l'Adour et l'extrémité de la Fosse de Cap Breton.

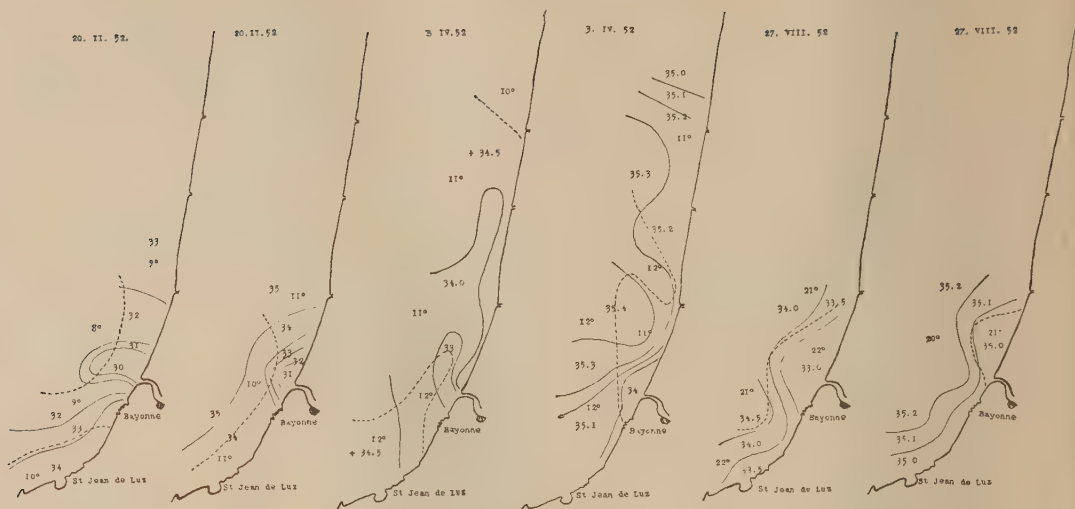
A l'embouchure de l'Adour on observe des salinités de 30 à 31 ‰ en Février, de 33.8 en

Secteur VIII a, b. De l'île d'Yeu à l'île d'Oléron.

Navire: Vedette Garde Pêche «Quartier Maître Balanec».

Observateur: LETACONNOUX.

St.	Heure	Latitude	Longitude	Prof. m.	t°	S ‰	St.	Heure	Latitude	Longitude	Prof. m.	t°	S ‰
1 Septembre							3 Septembre						
1	1530	46°31'	1°54'30"	0	20.60	34.76	11	0730	46°23'	1°44'	0	19.70	34.78
				20	19.10	34.87					15	19.80	34.79
2	1600	46°34'	2°01'	0	20.60	34.79	12	0840	46°18'30"	1°41'	0	19.70	34.81
				20	17.95	34.81					15	19.70	34.85
3	1700	46°37'30"	2°07'	0	19.60	34.74	13	0920	46°14'	1°38'	0	19.95	34.69
				20	18.40	34.79					10	19.85	34.67
4	1830	46°41'	2°11'	0	19.85	34.78	14	1000	46°11'	1°35'30"	0	20.00	34.63
				20	18.10	34.85					10	19.80	34.61
2 Septembre							15	1045	46°08'	1°32'30"	0	20.55	34.52
5	0900	46°54'	2°22'30"	0	18.80	35.10					20	20.30	34.51
				10	18.55	35.05	16	1135	46°03'	1°30'	0	20.60	34.47
6	1000	46°49'30"	2°23'30"	0	18.70	34.97					20	20.45	34.47
				15	18.60	35.01	17	1400	45°58'30"	1°28'30"	0	20.60	34.45
7	1125	46°41'30"	2°06'	0	19.50	34.79					20	19.70	34.56
				10	19.10	34.81	18	1500	46°07'	1°21'30"	0	20.05	34.47
8	1220	46°41'	1°57'30"	0	20.15	34.87					20	20.00	34.54
9	1400	46°36'	1°55'30"	0	20.05	34.79	19	1530	46°07'	1°17'	0	20.50	34.67
				15	19.35	34.83					20	20.45	34.69
10	1500	46°26'30"	1°51'30"	0	20.45	34.70							
				20	20.05	34.72							

Figure 8,
en surface.Figure 9,
sur le fond.Figure 10,
en surface.Figure 11,
sur le fond.Figure 12,
en surface.Figure 13,
sur le fond.

Figures 8—13. Région Basco-Landaise, 20 Février, 3 Avril, 27 Août 1952.

Secteur VIII b. Pays Basque. Côte des Landes.

Navire: Vedette Garde Pêche «Administrateur Thomas».

Observateurs: LETACONNOUX et LE DANTEC.

St.	Latitude	Longitude	Prof. m.	Date: 20 Février		3 Avril		27 Août	
				t°	S ‰	t°	S ‰	t°	S ‰
1	43°24'30	1°41'30	0	10.10	34.29	12.20	34.65	22.90	33.84
			25	—	—	—	—	20.45	35.05
2	43°27'00	1°37'30	0	10.60	34.13	—	—	—	—
			25	11.30	34.81	—	—	—	—
3	43°29'00	1°35'00	0	9.50	34.27	11.75	34.25	22.60	34.54
			20	11.20	34.85	12.25	34.94	20.60	35.16
4	43°32'30	1°33'30	0	9.20	32.14	11.50	34.58	22.10	33.21
			25	11.10	31.29	—	—	20.65	35.21
5	43°36'00	1°00'30	0	9.20	32.63	12.00	33.86	22.30	33.40
			25	11.20	34.98	11.95	35.43	21.05	35.01
6	43°39'00	1°29'00	0	9.80	33.89	—	—	21.75	33.71
			25	11.35	35.05	—	—	20.35	35.17
6 bis	43°41'00	1°28'30	0	—	—	11.60	34.63	—	—
			25	—	—	12.00	35.35	—	—
7	43°36'50	1°34'00	0	8.80	32.32	11.60	34.22	—	—
			25	11.20	34.99	11.90	35.43	—	—
7 bis	43°40'00	1°34'00	0	—	—	—	—	21.50	34.29
			25	—	—	—	—	20.90	35.28
8	43°33'30	1°36'30	0	8.60	30.46	11.60	34.14	22.70	33.37
			25	10.80	34.78	12.10	35.37	20.45	35.25
8 bis	43°36'00	1°37'00	0	—	—	—	—	21.90	34.14
			25	—	—	—	—	20.95	35.26
9	43°30'00	1°39'30	0	9.40	32.66	12.00	34.74	21.85	34.88
			25	10.80	34.90	12.40	35.12	20.60	35.28
10	43°27'40	1°42'30	0	9.75	33.77	—	—	—	—
			25	10.80	34.99	—	—	—	—
11	43°47'00	1°28'00	0	—	—	11.30	34.36	—	—
			25	—	—	11.85	35.28	—	—
12	43°53'00	1°25'00	0	—	—	11.00	34.78	—	—
			25	—	—	11.80	35.28	—	—
13	43°57'30	1°27'30	0	—	—	10.75	34.61	—	—
			25	—	—	11.30	35.08	—	—
14	43°49'30	1°29'30	0	—	—	11.20	34.52	—	—
			25	—	—	11.75	35.30	—	—
15	43°43'30	1°32'00	0	—	—	11.80	34.63	—	—
			25	—	—	12.00	35.25	—	—

Avril et de 33.2 en Août alors que les eaux du large, qui avancent près de côte au nord et au sud de cette embouchure, atteignent 33 à 34.5 ‰ en surface et 34 à 35.2 ‰ en profondeur.

D'une façon générale les eaux du fond en effet plus salées que celles de la surface et dans la région de la Fosse de Cap Breton nous avons même observé une véritable résurgence des eaux du fond amenant des eaux à 35.4 ‰ près de côte (Mai).

Il est à noter également que l'écoulement des eaux de l'Adour semble se faire près de côte en direction du nord comme en témoignent les observations du mois de Mai qui montrent un étalement vers le nord des eaux à 33.8—34 ‰.

R. LETACONNOUX.

Observations Hydrologiques au Large de Dakar.

Des observations hydrologiques ont été régulièrement poursuivies depuis 1946 par le Laboratoire de Biologie Marine de Gorée (température) et la Section Technique des Pêches Maritimes de Dakar (température-salinité). Les résultats bruts ont été publiés au *Bulletin du Comité local d'Océanographie et d'Etude des Côtes d'A.O.F.* en 1948 et 1949.

En se basant sur ces résultats BERRIT, Océanographe de l'Office de la Recherche Scientifique Outre-Mer, a précisé ce qu'il a appelé le *climat marin de la «Petite Côte»*, c'est à dire les conditions régnant sur le plateau continental entre Cap Vert et Gambie jusqu'aux profondeurs de 100 mètres¹).

Il y distingue trois saisons :

1. *Saison froide et salée* (seconde quinzaine de Décembre à seconde quinzaine de Mai).

Températures moyennes —

18° à 19° en surface

14° à 50 mètres

13.5° à 100 mètres

Salinité — 35.5 ‰ en surface avec diminution d'environ 0.5 ‰ pour un accroissement de profondeur de 30 m.

2. *Saison chaude et salée* (seconde quinzaine de Mai à seconde quinzaine de Juillet).

Elévation brutale de la température de surface qui augmente de sept à huit degrés en moins d'un mois.

La salinité est légèrement plus élevée que durant la saison froide.

3. *Saison chaude et dessalée* (seconde quinzaine de Juillet à seconde quinzaine de Décembre).

Vers la fin du mois de Juillet, une dessalure apparaît au sud et progresse vers le nord. En surface, le domaine des eaux dessalées (moins de 35 ‰) s'étend jusqu'au mois d'Octobre. L'épaisseur de cette masse ne dépasse guère vingt ou trente mètres, et, dès le mois d'Août, des eaux froides apparaissent en profondeur au large du Cap Vert.

La température moyenne de surface durant la saison chaude et dessalée est d'environ 28°.

D'après BERRIT, les variations observées seraient dues au mouvement de masses d'eaux indépendantes les unes des autres et se repoussant mutuellement dans un mouvement alternatif nord-sud, sud-nord.

Les observations récentes effectuées par la Section Technique des Pêches Maritimes au large de la Pointe des Almadies (14° 46' N. — 17° 35' W.) confirment cette hypothèse de masses d'eaux indépendantes, en raison même de la rapidité des variations enregistrées (voir tableau ci-dessous).

Températures au point A 1 entre 10 h 30 et 11 h.

	Surface	50 m.	100 m.
13. 12. 1951.....	22.8°	18.6°	16.8°
19. 4. 1952.....	17.6°	15.6°	14.4°
13. 5. 1952.....	18.4°	16.05°	14.5°
29. 5. 1952.....	24.2°	17.9°	15.95°
18. 6. 1952.....	26.4°	22.8°	16.9°

La masse d'eau chaude se manifeste dès la première quinzaine de Mai. Il est probable qu'elle vient non pas du sud, mais du sud-ouest. Au cours d'un voyage aux Iles du Cap Vert, en Février, le «Gérard Tréca» a noté une augmentation progressive de la température qui se traduisait par une différence de trois degrés au bénéfice des stations les plus à l'ouest sur le parallèle 14°45' N. entre les méridiens 18° W. et 24° 45' W.

En Décembre, les eaux restent chaudes, même en profondeur, ce qui paraît en opposition avec les conclusions de BERRIT. Cependant les observations de ce dernier ont été faites à l'abri du Cap Vert et sans doute

¹) G. R. BERRIT, Esquisse des conditions hydrologiques du plateau continental du Cap Vert à la Gambie — à paraître Bull. I.F.A.N.

soumises à un phénomène «de Cap» auquel il a d'ailleurs fait allusion.

Les conditions hydrologiques assez irrégulières sur la Petite Côte se stabilisent en dehors du plateau continental où deux périodes seulement restent marquées.

Une période froide de Décembre à Mai.

Une période chaude de Juin à Novembre.

A chacune de ces périodes correspond d'ailleurs une faune pélagique nettement caractérisée.

E. POSTEL.

Plancton et Faune.

Les Faciès Bionomiques des Côtes du Sénégal.

Dans un travail d'ensemble effectué au cours des années 1949 et 1950, le «Gérard Tréca», chalutier de la Section Technique des Pêches Maritimes de Dakar, a dressé une carte générale des fonds de pêche du Sénégal et poursuivi l'inventaire de la faune commencé en 1936 par le «Président Théodore Tissier». Une vingtaine d'espèces nouvelles ont été découvertes¹⁾.

L'acquisition en 1952 d'un sondeur ultrasonore enregistreur (Sondeur S. C. A. M. Indicateur 419) m'a conduit à préciser certains détails et à établir les faciès bionomiques le long de parallèles sensiblement perpendiculaires à la côte et s'étageant de 30 minutes en 30 minutes.

Méthode de travail adoptée. Le parallèle est d'abord parcouru de façon à relever un profil d'ensemble. Ensuite un certain nombre de traits de chalut est effectué à 25 mètres, 50 mètres, 100 mètres et 200 mètres (précision 10 %). L'inventaire de chacun est porté sur une fiche dont le modèle est donné ci-dessous.

Le plateau continental sénégalais est marqué, surtout au sud du Cap Vert, par deux saisons, une saison froide: de Décembre à Mai, une saison chaude de Juin à Novembre,

qui déterminent, même dans la faune benthique, des changements appréciables.

Il est donc indispensable, pour avoir une vue complète, de répéter deux fois les mêmes opérations, une fois dans chaque période.

Les recherches ont débuté en Avril sur le parallèle 14°30' N. Elles ont donné les résultats suivants: —

Au point de vue topographique: — le plateau continental est marqué par deux accidents remarquables.

1. Un seuil madréporique à 100 mètres (voir Figure 14 a).

2. Une rupture de pente à 130 mètres. (La pente passe brusquement 0.25 % environ à 3.75 % — voir Figure 14 b).

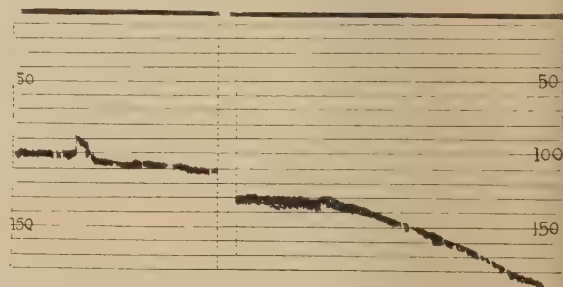


Figure 14 a

Figure 14 b

Chalutier «Gérard Tréca».

Sortie du

Lieux de Pêche	Durée du Trait	Profondeur	Température	Nature du fond	Inventaire	Espèces dominantes (quantités)	Observ.

¹⁾ Voir à ce sujet les publications de J. CADENAT — IFAN — Dakar.

Fonds de 25 mètres.

Les fonds de 25 mètres sont caractérisés par la présence d'*Arca*, de *Chama*, de Balanes, de Vérétilles, de Gorgones et d'Ascidies.

On y rencontre quelques *Cymbium* et quelques Crustacés (*Palinurus regius* et *Calappa rubroguttata*) ainsi que des Céphalopodes (*Sepia*).

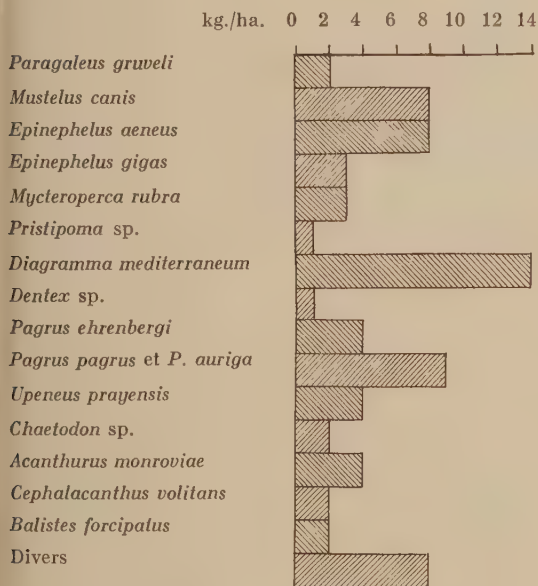


Figure 15. Parallèle 14°30'.
Fonds de 25 m., saison froide.

Faune ichthyologique: —

Densité: — 75 kg. à l'hectare.

Répartition des espèces (voir graphique, Figure 15).

Composition de la rubrique divers: *Trigla* sp., *Pagellus* sp., *Coris julis*, *Bodianus* sp., *Psettodes Belcheri*, *Syacium micrurum*, *Chylomycterus antennatus*, *Raia miraletus*, *Torpedo* sp.

Fonds de 50 mètres.

Les fonds de 50 mètres sont caractérisés par la présence d'*Arca*, de *Chama*, de Gorgones et de Pennatules.

On y rencontre quelques Echinodermes et quelques *Cymbium* ainsi que des Céphalopodes (*Sepia*).

Faune ichthyologique: —

Densité: — 60 kg. à l'hectare.

Répartition des espèces (voir graphique, Figure 16).

Composition de la rubrique divers: *Chaetodon* sp., *Balistes forcipatus*, *Holocentrus hastatus*, *Zeus faber*, *Scomber colias*, *Syacium micrurum*, *Squatina* sp., *Raia miraletus*.

Fonds de 100 mètres.

Les fonds de 100 mètres sont caractérisés par des récifs coralliaires et madréporiques vivants (*Dendrophyllia ramea*), des Gorgones et des Avicules.

On y rencontre quelques Echinodermes (*Centrostephanus longispinnus*).

Faune ichthyologique: —

Mal connue en raison des avaries constantes survenues aux chaluts à cette profondeur.

Les *Diagramma mediterraneum*, *Acanthurus monroviae* et *Upeneus prayensis*, nombreux aux niveaux supérieurs, ont disparu.

Priacanthus arenatus semble constituer l'espèce dominante.

Fonds de 200 mètres.

Les fonds de 200 mètres sont particulièrement doux, vaseux ou vaso-sableux.

On y rencontre quelques Echinodermes (*Cidaris cidaris meridionalis*), quelques Gastéropodes (*Xenophora*) et des Céphalopodes

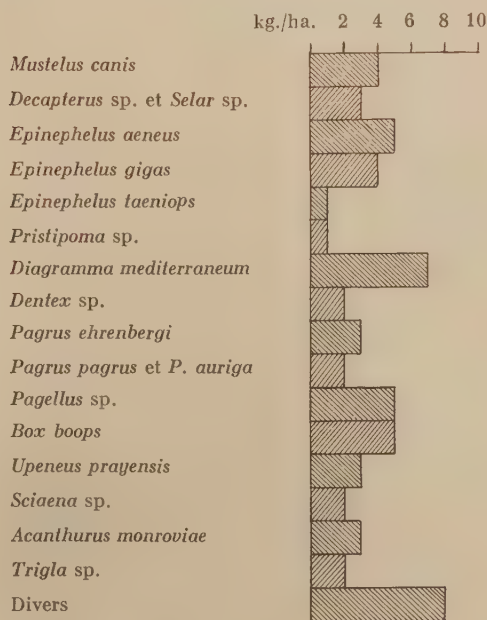


Figure 16. Parallèle 14°30'.
Fonds de 50 m., saison froide.

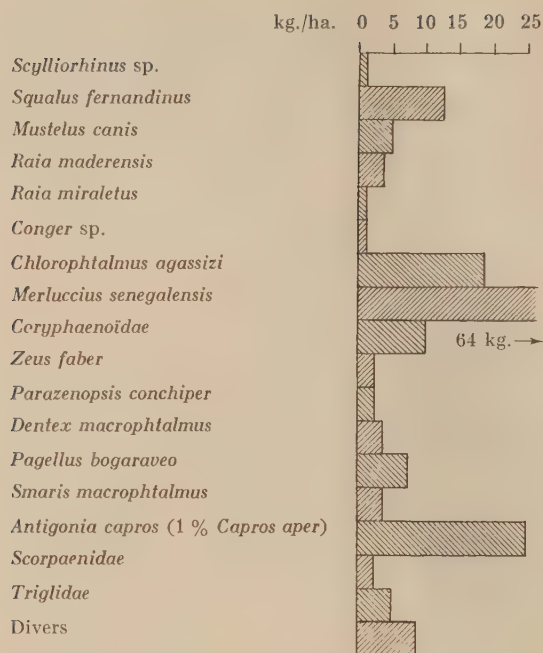


Figure 17. Parallèle 14°30'.
Fonds de 200 m., saison froide.

(*Octopus*) ainsi que des Crustacés (*Palinurus mauretanicus* et *Parapenaeus longirostris*).

Faune ichthyologique: —

Densité: — 160 kg. à l'hectare.

Répartition des espèces (voir graphique, Figure 17).

Composition de la rubrique divers: *Aulopus filamentosus*, *Pterothrissus belloci*, *Synagrops microlepis*, *Epigonus* sp., *Emmelichtys* sp., *Callionymus phaëton*, *Peristedion macronema*, *Liosaccus cutaneus*, *Solea hexophtalma*, *Chascanopsetta lugubris*.

Les recherches se poursuivent actuellement sur le parallèle 14° et seront étendues si possible du Cap Blanc au Dahomey.

Une étude particulière de la Fosse de Cayar sera entreprise dès l'année prochaine. Un coup de chalut donné par 200 m. de profondeur sur son versant sud-ouest a révélé un curieux faciès à dominance de *Gephyroberyx darwini* (60 % des prises) et *Brotula barbata* (20 % des prises); la densité atteint 300 kg. à l'hectare et les plus gros exemplaires battent les records jusqu'à maintenant enregistrés (51 cm. et 2.95 kg. pour *G. darwini*, 67 cm. et 2.57 kg. pour *B. barbata*).

Le Trou sans fond, près d'Abidjan, fera l'objet d'une prospection spéciale.

E. POSTEL.

Scottish Plankton Investigations.

The Scottish programme of plankton work in 1952 included a survey of the fauna of the waters approaching the Faroe Channel and Scottish area in June. This work included a few stations in the Atlantic Slope Committee's area to the west of Barra Head and off the north-west coast of Ireland. The results showed that there was a community of "Lusitanian" species between approximately 750 m. and 250 m. depth, for example: *Sagitta lyra*, *Stylocheiron elongatum*, *Arachnomysis leukarti*, *Salpa fusiformis*, *S. (= Ihlea) asymmetrica*, *Doliolitta gegenbauri*, the heteropod *Carinaria lamarki*, the polychaetes *Vanadis formosa*, *Calizona angelini* and a long list of siphonophores including *Velella*, *Bassia bassensis*, *Nectopryamys thetis*, *Vogtia spinosa*, *Hippopodius hippopus*, *Chelophyes appendiculata*, *Lensia conoidea* and *Agalma elegans*. This fauna probably originated in the region of the Azores and can be traced following the edge of the continental shelf to the Faroe Channel and Shetland. It lay between an upper layer of Atlantic water and a lower deep layer containing boreal species. These results are associated with the more northerly results in reports to the North-Western Area and North Sea Committees.

J. H. FRASER.

Copépodes Pélagiques capturés en Manche, en Surface, au Cours de la Croisière du Navire Océanographique «Président Théodore Tissier» en 1949.

En Mai, puis en Septembre et Octobre 1949, le «Président Théodore Tissier» a procédé aux stations indiquées sur la carte jointe (No. 1 à 362), à des pêches de plancton en surface à l'aide d'un filet conique, (en étamine: stations 1—10, 10—25 en Mai, 274—292 Septembre, ou en soie (60 mailles au pouce): stations 354—362), d'un mètre de long et de 35 centimètres de diamètre.

Les Copépodes, Acartiidés, Centropagides, Calanidés constituant les éléments dominants dans le plancton, se répartissaient ainsi (espèces et abondance relative): —

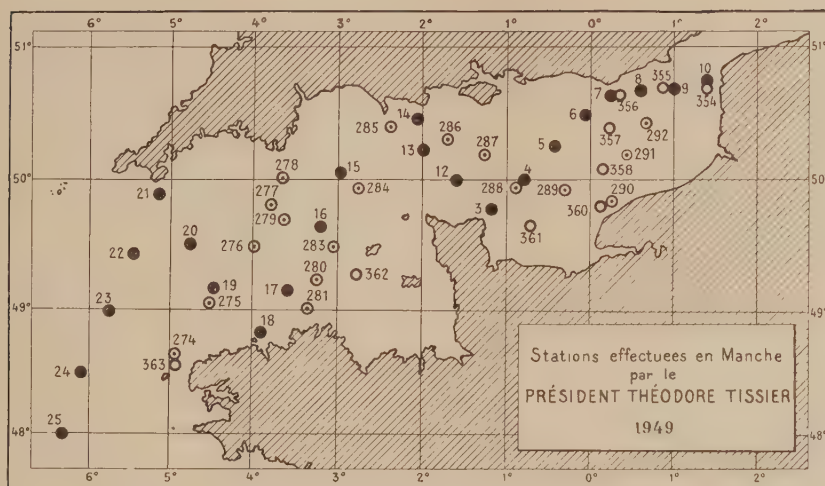


Figure 18.

Acartiidés.*Acartia clausi* GIESBRECHT.

- En Mai, présent au sud des côtes anglaises aux stations 21 et 15. Domine à l'entrée occidentale de la Manche (station 22);
- en Septembre et en Octobre, trouvé en Manche orientale dans toutes les stations situées à l'est du 4° de longitude (station 362 exceptée).

Cette espèce représente parfois plus de 75 % du volume total du plancton capturé.

Acartia discaudata GIESBRECHT.

- En Mai, stations 3, 4, 8, 10, 16, 18, 19, 20, 22. En Manche occidentale, domine aux stations 16, 18, et 19;
- en Septembre, domine à la station 274; peu abondante aux stations 277, 281, 286;
- en Octobre, très peu abondante aux stations 318 et 324 en Manche orientale.

Centropagides.

Variation saisonnière, marquée dans l'abondance et la fréquence des deux espèces suivantes : —

Centropages hamatus LILLJEBORG.

- En Mai, distribution dans toute la Manche;
- en Septembre, devient rare en Manche occidentale (une seule présence près de la côte de Bretagne à la station 274), et moins fréquent en Manche orientale (stations 281, 282, 284, 287, 288);
- en Octobre, disparaît dans toutes les récoltes.

Centropages typicus KRÖYER.

- En Mai, largement réparti dans toute la Manche, et cohabite parfois avec *Centropages hamatus* LILLJEBORG;
- en Septembre, abondant (stations 281, 282, 284, 287) aux entrées occidentale et orientale de la Manche;
- en Octobre, présent aux stations 355, 357 et 362 en Manche orientale.

Calanidés.*Calanus finmarchicus* GUNNER.

Espèce cosmopolite très fréquente et répartie à presque toutes les stations (Mai: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 20, 21, 22, 23, 25. — Septembre: 274, 276, 277, 278, 281, 282, 284, 285, 286, 288, 291, 292. — Octobre: 356, 358).

Ce Calanidé, généralement peu abondant, domine exceptionnellement aux stations 3 et 4 à l'est de la pointe de Barfleur.

Autres espèces.

Temora longicornis MÜLLER est fréquent en Mai dans la plupart des stations de la Manche. Il domine dans le secteur correspondant aux stations 7, 8, 9, 10, 12, limité à l'ouest par le 1° de latitude est.

— En Septembre, sa répartition est différente. Il domine dans toutes les stations de la Manche orientale, à l'est du 1° de latitude, particulièrement aux stations 287, 288, 289. Il est rare, au contraire, en Manche occidentale (stations 281, 282).

— En Octobre, il est présent dans les stations faites en Manche orientale, à l'est du 0° de longitude et à la station 362 assez voisine de la station 281 en Manche occidentale où il a été déjà signalé en Septembre.

Paracalanus parvus CLAUS capturé en Septembre en Manche occidentale (stations 274, 277, 281); en Octobre, en Manche orientale (stations 354 et 358).

Pseudocalanus elongatus BOECK, rare.

Deux captures en Mai en Manche occidentale (stations 17 et 22) et en Septembre en Manche orientale (station 288).

Coryceus angelicus LUBBOCK.

En Mai, quelques individus isolés présents à l'entrée occidentale de la Manche (stations 20, 22, 23) puis au sud de Start-Point en Septembre (station 278) ont été identifiés.

Quelques rares Pontellides ont été également récoltés. *Anomalocera patersoni* TEMPLETON est représentée par deux spécimens à l'entrée occidentale de la Manche, en Mai (station 22) et par un seul spécimen en Manche orientale (station 289) en Septembre.

Labidocera wollastoni LUBBOCK est très rare au sud des côtes anglaises et aux seules stations 285 et 297 (Septembre).

Un seul exemplaire de l'espèce *Parapontella brevicornis* LUBBOCK mâle a été capturé en Septembre à la station 287.

Nous attirons l'attention sur l'extrême rareté de l'Harpacticide *Euterpina acutifrons* DANA, recueilli une fois seulement, en Septembre à la station 291, en Manche orientale, et une fois en Octobre aux stations 358, 359 voisines de la station 291.

Nous ne pouvons attribuer cette rareté au mode de capture, car des essais pratiqués avec ces mêmes filets avaient donné pour cette espèce des résultats concluants.

Les travaux de SCOTT ont déjà signalé l'abondance ou la rareté de l'espèce pendant les années 1903 à 1907; elle ne peut être attribuée, en 1949, au mode de capture employé: les mêmes engins ayant donné ailleurs des résultats positifs pour *Euterpina acutifrons*.

J. FLEURY.

LES POISSONS

CLUPÉIDÉS

Sardine (*Clupea* = *Sardina pilchardus* WALB).

Répartition des Concentrations dans le Golfe de Gascogne.

Le Tableau 1 donne la longueur moyenne des sardines du Golfe de Gascogne observée en 1952 dans les différents centres de pêche.

La Figure 1 montre la répartition de ces sardines d'après leur taille dans les centres

précités, ceci d'Avril à Octobre (durée de la saison de pêche).

En comparant ces résultats avec ceux antérieurement publiés (cf. Ann. Biol., Vol. VIII, 1951 et Vol. VII, 1950), l'année 1952 se caractérise: —

a) par la pénurie, au début de la saison, de jeunes sardines immatures, dites «de roques», de 11 à 12.5 cm. (2 ans). Elles n'apparaissent qu'en Septembre dans les secteurs

Tableau 1. Longueur moyenne de la Sardine du Golfe de Gascogne 1952.

Mois	Douarnenez Audierne	Penmarch Concarneau	Etel Quiberon Belle-Ile	Entre Loire et Gironde	Arcachon St-Jean-Luz
Avril.....	17, 18 (P)				12.5—14.0
Mai.....	19 à 23 (C) 19—23 (C)		15.0		14.0—15.0
Juin.....	13.0—16.0	15.0—15.5	13.5—14 15.0—15.5	15.0	15.0
Juillet.....	19—23 (C) 16.5	15.5—16.0	15.5—16.0	15.5	15.0
Août.....	16.5 à 17.5	16.0—16.5	16.0—16.5	16.0 à 16.5	15.0
Septembre.....	18.0	16.5—17.5	12.5 à 14 et 17	14.0 à 14.5	15.5—16.0
Octobre.....	17—18	17.5	13 à 14.0 et 16.5		

P = Sardines profondes

C = Sardines coureuses

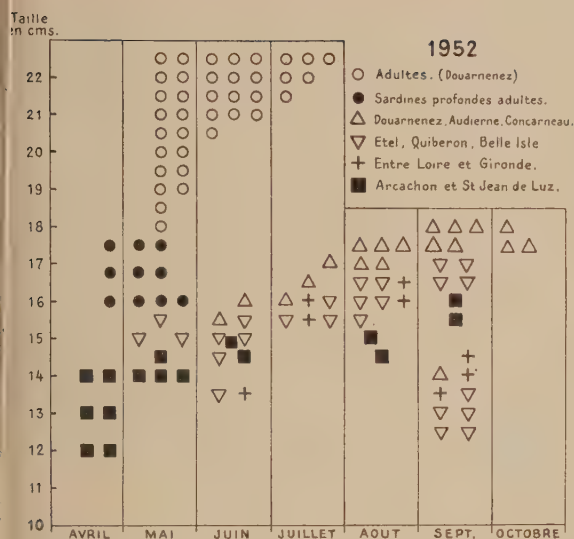


Figure 1. Longueur et croissance de la Sardine du Golfe de Gascogne pendant la saison de pêche (Avril—Octobre 1952).

- d'Étel-Quiberon-Belle-Ile; puis entre la Loire et la Gironde. Leur taille varie à ce moment de 125 à 145 mm.
- b) par la dominance sur toutes les pêcheries, de sardines adultes de 15 cm. à 18 cm. Leur taille augmente progressivement, ainsi qu'il l'a été régulièrement constaté chaque année. (cf. Ann. Biol. 1951—1950).

JEAN LE GALL.

Contribution à l'Étude de la Nourriture de la Sardine du Golfe de Gascogne.

Deuxième note.

Matériel et technique d'analyse.

Cette étude sur l'alimentation de la sardine des côtes méridionales de la Bretagne a porté sur des contenus stomacaux prélevés sur des poissons capturés en 1952, à Quiberon (le 18 Juillet et les 5 et 27 Août), au Croisic (le 6 Août), à Lorient (le 5 Septembre), cependant que des prises de plancton étaient effectuées au voisinage des lieux de pêche de ces poissons.

D'une façon générale, les exemplaires larvaires de Crustacés (Brachyours et Anomoures) étaient difficilement déterminables à l'exception d'une forme que nous croyons être: *Pontophilus speciosus*. Les Périidiniens, au contraire, étaient dans un état de conservation parfait.

L'abondance et la fréquence de chaque espèce ont été notées pour en apprécier le rôle et l'importance dans le régime alimentaire de la sardine.

Composition de la nourriture.

L'analyse des contenus stomacaux révèle l'importance des groupes planctoniques suivants:

Zooplancton.

Copépodes.

Centropages typicus KRÖYER, rare à Quiberon; déjà signalé dans des sardines de Concarneau par MANGIN (1912) et dans des sardines de la Manche et du Golfe de Gascogne par FAGE (1912) et FLEURY (1948).

Euterpina acutifrons DANA, très fréquente, domine parfois dans les lots de sardines du Croisic.

POUCHET et DE GUERNE (1887) mentionnèrent ce Copépode dans des sardines prélevées aux mois de Juin, Juillet, Août et Septembre à Concarneau et au mois de Juin à la Corogne et FLEURY (1948): en Décembre à Biarritz.

Microsetella rosea DANA, exceptionnelle au Croisic en Août. Nous l'avions rencontrée en Décembre 1946 (très rare) et Janvier et Avril (très commune), 1947, dans des sardines de la côte basque.

Des *Setella* furent également identifiées par MARION (1889) dans des estomacs de sardines du Golfe de Marseille.

Oithona helgolandica CLAUS, assez peu abondante au Croisic (Août).

Pseudocalanus elongatus BOECK, peu abondant à Quiberon en Juillet.

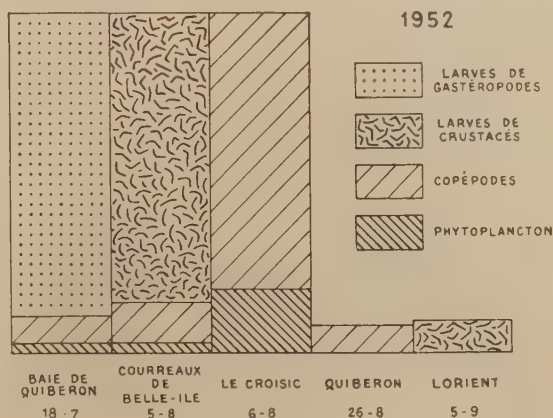


Figure 2.

Les nauplii de Copépodes sont moyennement abondants au Croisic (Août). DESBROSSES (1933) en mentionna pendant la saison d'été et FLEURY (1948) en Novembre exceptionnellement, devant Biarritz.

Cirrhipèdes.

Les nauplii de Cirrhipèdes sont rares dans les estomacs de sardines du Croisic et absents ailleurs.

Anomoures.

Les larves de Crustacés représentant l'essentiel d'un régime alimentaire abondant, le 5 Août dans les coureaux de Belle-Ile, colorent les contenus stomacaux en rose intense. Elles sont peu abondantes au Croisic et à Lorient.

Mollusques.

Les larves de Gastéropodes sont abondantes dans les estomacs des sardines de Quiberon et colorent en brun noir les contenus stomacaux.

Phytoplancton.

Coscinodiscus radiatus (rare) et *Peridinium divergens* (assez communs) sont les seuls éléments du plancton végétal représentés au Croisic le 6 Août.

Les organismes végétaux recueillis dans les estomacs correspondent généralement aux familles et genres cités par les Auteurs. Les divergences dans les espèces s'expliquent par les variations de latitude qui influencent la distribution du plancton.

Tableau 2.

Dates de pêche	1952 18 Juillet		1952 5 Août		1952 6 Août		1952 6 Août		1952 26 Août	
Lieux de pêche	Baie de Quiberon		Coureaux de Belle-Ile 47° 20' 3° 4'		Le Croisic 47° 12' 2° 30'		Le Croisic 47° 13' 2° 35'		Coureaux de Belle-Ile 47° 24' 3° 9'	
Liste des captures	A	B	A	B	A	B	A	B	A	B
<i>Ceratiun fusus</i>	+									
<i>Coscinodiscus grani</i>					+				+	
<i>C. radiatus</i>							+	+		
<i>Peridinium divergens</i>					+	+	++	++		
<i>Rhizosolenia</i> (sp.).....					+					
<i>Thalassiothrix nitzschioides</i> ...					++					
<i>Acartia clausi</i>										
<i>A. discadata</i>	+		+		+				+	
<i>C. finmarchicus</i>			+							
<i>Centropages typicus</i>	+++	+	+	+					++	
<i>Euterpina acutifrons</i>	±±±±	++		+	+	±±±±	±±±±	±±±±	+	+
<i>Isias clavipes</i>			+						++++	
<i>Microsetella rosea</i>	+									
<i>Oithona helgolandica</i>	+				±±±±	+	++	+		
<i>Oncea mediterranea</i>	+								+	
<i>Paracalanus parvus</i>	+						+			
<i>Pseudocalanus elongatus</i>		+	+							
<i>Pontellide</i> (?).....									+++	
<i>Temora longicornis</i>	+++				+		+		+	
<i>Evadne spinifera</i>	+		+		+		+			
<i>Podon intermedius</i>	+				+					
Zoés de crabes.....			+						+	
— de porcellanes.....	+		+							
Larves de Décapodes.....			++	±±±±	+	+	+		+	
Nauplius de Cirrhipèdes.....					+		+			
Cypris de Cirrhipèdes.....	+		+		+					
Nauplius de Copépodes.....	+++				+	+		+		
Larves de Gastéropodes.....	++	±±±±			+		+		+	
Larves de Lamellibranches										
Appendiculaires (<i>Oikopleura</i>)					+		+			
Chaetognathes.....							+		+	

A = Filet pélagique. B = Contenu stomacal.

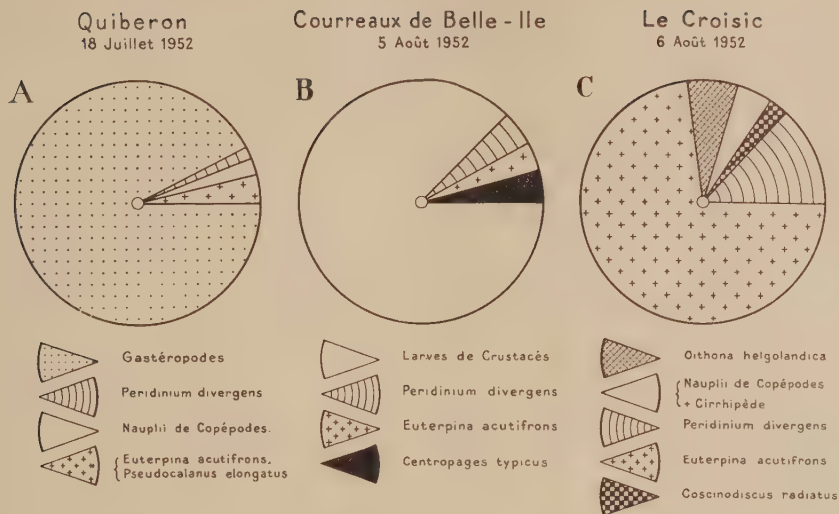


Figure 3.

Abondance et fréquence des espèces.

L'abondance relative des groupes énumérés dans les contenus stomacaux est représentée par le schéma de la Figure 2.

C'est à la fin de Juillet et au début d'Août que le régime alimentaire est le plus abondant et le plus varié. Les différentes espèces se répartissent alors suivant le schéma de la Figure 3. (A. B. C.).

R. LEWIS (1923), étudiant les habitudes alimentaires de la sardine de Californie, conclut à une relation définie entre la distribution saisonnière du microplancton et du zooplancton et l'alimentation de la sardine. Pour établir cette relation, nous indiquons dans le Tableau No. 2 la fréquence des éléments capturés au filet pélagique, aux divers points de notre étude, et celle des éléments rencontrés dans les contenus stomacaux. Nous avons souligné d'un trait les espèces prédominantes.

L'examen de ce tableau montre la fréquence des Péridiniens et des Copépodes dans la diète de la sardine. *Euterpina acutifrons* DANA est toujours présent dans les estomacs, même lorsqu'il manque dans les filets pélagiques. BLIN, en 1923, émit l'opinion que la sardine le recherche comme un aliment de choix. La masse des œufs de ce Copépode, représentant, en effet, un volume égal à la moitié du corps de l'animal, constitue pour la sardine une véritable «rogue vivante». C'est aussi aux lieux où *Euterpina acutifrons* DANA a été très abondante que le plus grand nombre de sardines a été pêché.

Mais, d'une façon générale, rejoignant les conclusions de DESBROSSES (1933) et d'HICKLING (1945) sur la grosse sardine d'été, nous pouvons dire que les variations saisonnières dans le régime de la sardine sont en relation avec l'apparition des formes planctoniques à des époques déterminées de l'année.

JACQUELINE FLEURY.

La Sardine des Côtes du Portugal en 1952.**Pêche.**

La production totale a été à peu près la même qu'en 1950 et 1951, c'est-à-dire, 80,000 tonnes environ, dont un tiers débarqué au port de Leixões (près de Porto). Ce niveau de production s'est établi après les deux années critiques de 1948 et 1949, pendant lesquels la quantité de sardine débarquée a baissé à 56,000 et à 36,000 tonnes, respectivement la moitié et un tiers environ de la production moyenne des huit années précédentes, qui fut de 100,000 tonnes environ.

Matériel recueilli.

Les observations ont été effectuées à : 1) Leixões, sur 41 échantillons hebdomadaires de 200 sardines environ, comprenant en tout 8,000 exemplaires (observateur, M. J. MACHADO CRUZ); 2) Lisbonne, sur 55 échantillons du même genre, comprenant 10,000 sardines (observateurs, Messieurs A. M. RAMALHO, J. SANTOS PINTO, J. TIAGO DE OLIVEIRA et autres

Tableau 3.

Taille par classes de 1 cm. de la longueur (A), par mois, et en ‰.

a) Leixões.

Longueur: cm.													
(A)	(B)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
9,25	10,3	8	—	—	—	—	—	—	1	—	—	—	—
10,2	11,4	5	—	—	—	—	—	1	13	6	—	—	1
11,2	12,5	84	10	—	—	—	—	14	110	148	13	4	35
12,2	13,6	211	280	—	48	2	—	21	118	323	170	124	153
13,2	14,7	219	397	—	102	85	100	6	82	265	535	418	418
14,2	15,8	327	223	—	327	400	485	258	19	48	198	152	240
15,2	16,9	115	82	—	398	326	260	514	199	38	35	65	68
16,2	18,0	13	5	—	105	160	80	175	259	118	25	137	65
17,2	19,1	13	3	—	15	27	49	11	157	46	18	71	16
18,2	20,3	5	—	—	5	—	21	—	34	8	6	25	4
19,2	21,4	—	—	—	—	—	5	—	8	—	—	4	—
N { Échantillons		4	3	—	2	3	4	4	5	4	4	4	4
Sardines		728	600	—	400	600	800	800	1,000	800	800	800	800

b) Lisbonne.

Longueur: cm.													
(A)	(B)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
6,2	7,2	—	—	—	—	—	—	—	—	—	—	—	2
7,2	8,0	—	—	—	—	—	—	2	—	—	—	—	41
8,2	9,2	—	—	—	—	—	—	89	—	—	—	—	80
9,2	10,3	—	—	—	—	—	—	61	—	2	3	—	89
10,2	11,4	—	—	—	—	—	—	127	42	34	72	—	59
11,2	12,5	—	1	—	—	—	—	135	283	106	162	4	94
12,2	13,6	3	43	—	—	—	—	14	148	295	65	22	90
13,2	14,7	11	261	45	13	78	9	1	24	202	84	17	38
14,2	15,8	15	216	433	116	346	535	202	2	49	27	16	9
15,2	16,9	10	51	408	480	334	350	251	144	74	88	299	40
16,2	18,0	111	119	52	295	181	68	87	227	178	245	508	179
17,2	19,1	515	230	45	79	49	27	29	96	51	176	104	161
18,2	20,3	296	76	15	15	11	9	1	32	7	50	24	92
19,2	21,4	36	3	—	1	1	2	1	2	2	25	6	26
20,2	22,2	3	—	2	1	—	—	—	—	—	3	—	—
N { Échantillons		4	4	2	4	4	4	7	6	5	7	4	4
Sardines		800	700	400	700	800	800	1,216	1,026	1,068	1,298	800	850

c) Portimão.

Longueur: cm.					
(A)	(B)	VIII	IX	X	XI
9,2	10,3	—	15	28	—
10,2	11,4	—	91	46	2
11,2	12,5	34	122	128	19
12,2	13,6	117	250	257	104
13,2	14,7	39	211	353	165
14,2	15,8	514	133	112	100
15,2	16,9	277	162	60	112
16,2	18,0	17	16	15	269
17,2	19,1	2	1	1	157
18,2	20,3	—	—	—	60
19,2	21,4	—	—	—	12
N { Échantillons		16	23	29	12
Sardines		1,600	2,300	2,900	1,200

Note pour le Tableau 3, a et c.

Longueur (A) — Jusqu'à la fourche de la caudale

(centre de la classe); cette longueur égale à 0.90 de la

Longueur (B) — Totale, caudale comprise.

collaborateurs); 3) Portimão (côte méridionale du Portugal), sur 80 échantillons de 100 exemplaires recueillis tous les jours de pêche pendant les mois d'Août à Novembre (observateur, M. ANTONIO FEU, industriel conservateur qui a bien voulu prêter sa collaboration).

Taille.

La taille a été mesurée du bout du museau à la fourche de la nageoire caudale (longueur A), au demi-centimètre le plus proche. Cette longueur correspond à 90 % de la longueur totale, caudale comprise (longueur B). Le Tableau 3 résume les observations groupées par mois et par classes de 1 cm., et les données sont exprimées en millièmes des nombres observés chaque mois.

Tableau 4.

Maturité sexuelle des femelles:

En ‰ par mois.

a) Leixões.

Stade	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1.....	51	47	—	32	73	154	180	200	824	275	246	90
2.....	185	134	—	100	400	660	817	784	176	717	551	579
3.....	334	280	—	95	196	35	3	17	—	7	177	197
4.....	325	406	—	311	287	63	—	—	—	—	26	107
5.....	102	84	—	426	25	86	—	—	—	—	—	27
6.....	3	21	—	16	4	—	—	—	—	—	—	—
7.....	—	29	—	21	15	3	—	—	—	—	—	—
N: sardines ...	314	382	—	190	275	397	367	416	484	407	390	401
Moyenne.....	3.3	3.4	—	4.0	2.8	2.3	1.8	1.8	1.2	1.7	2.0	2.4

b) Lisbonne.

Stade	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1.....	—	—	—	34	168	232	450	661	498	181	10	232
2.....	5	10	100	444	579	645	505	359	471	628	271	80
3.....	10	172	508	235	168	74	24	—	30	155	408	45
4.....	204	276	325	255	65	54	21	—	—	31	308	643
5.....	780	527	67	32	—	—	—	—	—	5	2	—
6.....	—	14	—	—	—	—	—	—	—	—	—	—
7.....	—	—	—	—	19	—	—	—	—	—	—	—
N: sardines....	387	279	240	349	416	405	424	239	333	425	409	314
Moyenne.....	4.8	4.4	3.4	2.8	2.1	2.0	1.6	1.3	1.5	2.1	3.0	3.1

A Leixões les modes mensuelles les plus fréquentes sont 14.2 (15.8) cm. de Janvier à Août et 13.2 (14.7) d'Octobre à Décembre, variant entre 12.2 (13.6) et 16.2 (18.0) selon les mois. A Lisbonne les modes sont un peu plus élevées, variant entre 14.2 (15.8) et 17.2 (19.1), mais en automne une autre mode apparaît souvent, à 12.2 (13.6) ou 13.2 (14.7) correspondant à la génération de 1952 (classe 0). A Portimão, où les observations portent sur quatre mois seulement, la mode correspondant à la nouvelle classe 0 fait son apparition au mois d'Août, avec 12.2 (13.6) cm.

Maturité sexuelle.

Le Tableau 4 résume les observations, sur les femelles seulement, effectuées à Leixões et à Lisbonne. Les sardines femelles présentent des gonades aux premiers stades du cycle de l'évolution sexuelle pendant les mois de Juillet à Octobre. Les stades les plus avancés sont rencontrés en Avril à Leixões et en Janvier et Février à Lisbonne. De ces observations, qui confirment d'ailleurs les plus anciennes faites à Lisbonne et en d'autres endroits de la côte du Portugal, il ressort que la période de ponte est assez longue, probablement entre les mois de Décembre et Juin ou même Juillet,

selon les régions. Le nombre en général assez réduit des femelles présentant des gonades aux stades 6 et 7 semble indiquer que les lieux de ponte sont placés au-delà de la zone où se fait la pêche commerciale.

Poids moyen.

Le Tableau 5 montre les résultats obtenus. D'une façon générale les moyennes mensuelles sont inférieures à la moyenne annuelle (pour chaque classe de taille) pendant les mois de Janvier à Juin, avec un minimum en Février, et supérieures de Juillet à Décembre, avec un maximum en Septembre ou Octobre. Les observations de 1952 concordent en grande partie, dans les lignes générales, avec celles effectuées autrefois à Lisbonne (1930—1933), mais il y a aussi quelques différences qui sont l'objet d'un examen détaillé en cours d'exécution.

Vertèbres.

Les observations portent sur 7,711 sardines de Leixões et 6,206 de Lisbonne (Tableau 6). Les moyennes mensuelles ont varié entre 51.22 et 51.42 à Leixões, avec une moyenne annuelle de 51.33 ± 0.023 , et entre 51.17 et 51.27 à Lisbonne, avec une moyenne annuelle de

Tableau 5.

Poids moyen.

Par mois et par classes de 0.5 cm. de la longueur (A).

a) Leixões.

Longueur: cm.													
(A)	(B)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
9.0	10.0	. 5.8	—	—	—	—	—	—	—	—	—	—	—
.5	10.5	. 8.0	—	—	—	—	—	—	. 6.0	—	—	—	—
10.0	11.1	—	—	—	—	—	—	—	. 9.0	.10.0	—	—	—
.5	11.7	.10.0	—	—	—	—	—	.15.0	.13.3	.12.5	—	—	.10.0
11.0	12.2	11.6	—	—	—	—	—	.15.0	14.9	14.1	.14.0	.14.0	.12.1
.5	12.8	13.7	.15.0	—	—	—	—	.15.2	17.2	17.6	.16.4	.16.0	14.5
12.0	13.3	15.9	17.2	—	.16.9	—	—	.17.3	19.6	19.6	16.9	17.4	16.6
.5	13.9	18.2	19.2	—	.18.0	.22.0	—	.20.0	21.3	22.4	22.8	20.4	18.8
13.0	14.4	21.1	20.9	—	21.4	.22.5	.24.3	.24.0	24.1	25.2	24.9	22.7	21.7
.5	15.0	23.6	23.7	—	25.1	24.4	26.2	.29.8	26.7	28.2	27.9	25.6	25.3
14.0	15.5	26.3	26.5	—	28.0	27.1	28.3	30.7	.30.8	32.2	32.0	28.9	28.3
.5	16.1	29.5	29.5	—	30.6	30.1	30.6	33.5	36.9	.40.4	35.5	32.4	31.4
15.0	16.6	33.2	32.9	—	34.0	33.1	33.7	36.3	39.9	.44.2	39.2	37.3	35.8
.5	17.2	37.1	.36.2	—	37.3	38.0	37.6	40.2	43.6	46.7	.46.5	44.5	41.0
16.0	17.8	.43.2	.42.3	—	41.8	42.3	31.6	44.9	49.4	50.7	.53.0	48.4	44.3
.5	18.3	.53.3	.45.0	—	.45.0	46.0	45.7	51.6	53.8	54.2	.56.7	52.7	50.5
17.0	18.9	.56.0	.52.0	—	.54.0	.50.0	51.0	.54.4	60.6	60.5	.62.1	59.1	.55.2
.5	19.4	.59.9	.53.0	—	.55.0	.60.0	.60.0	.65.0	66.2	.68.6	.65.3	64.2	.60.6
18.0	20.0	.64.0	—	—	—	—	—	.62.2	—	75.4	.74.0	.71.7	.68.3
.5	20.5	—	—	—	.75.0	—	.66.0	—	.86.7	.80.0	81.0	.86.8	—
19.0	21.1	—	—	—	—	—	.77.0	—	.94.5	—	—	.88.3	—
.5	21.6	—	—	—	—	—	.78.0	—	—	—	—	—	—

b) Lisbonne.

Longueur: cm.													
(A)	(B)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
9.5	10.5	—	—	—	—	—	—	—	—	. 8.3	.10.0	—	.7.5
10.0	11.1	—	—	—	—	—	—	—	.10.3	10.1	10.3	—	.9.3
.5	11.7	—	—	—	—	—	—	—	13.1	11.5	12.0	—	.11.0
11.0	12.2	—	—	—	—	—	—	—	14.3	14.2	13.5	.15.0	12.3
.5	12.8	—	.12.5	—	—	—	—	—	16.3	16.3	15.5	.15.5	14.3
12.0	13.3	.15.0	.15.0	—	—	—	—	—	18.7	18.4	18.5	.16.3	16.7
.5	13.9	.17.5	18.1	—	—	—	—	—	21.2	21.3	20.2	.19.2	18.9
13.0	14.4	.17.5	19.9	.21.0	.21.0	.21.4	—	—	24.3	24.7	23.8	.21.8	21.5
.5	15.0	.22.8	22.2	24.9	.24.4	24.1	.26.9	—	.27.9	27.3	26.8	.23.9	.23.6
14.0	15.5	.26.5	24.7	28.2	27.4	27.0	29.4	30.7	.29.0	31.6	33.0	.28.9	.26.3
.5	16.1	.27.7	28.7	31.2	30.6	30.5	31.8	33.2	.37.5	.35.5	.36.9	.32.4	.28.8
15.0	16.6	.30.5	31.7	34.3	33.7	34.0	34.7	36.3	41.4	40.7	40.2	38.0	.40.0
.5	17.2	.36.2	35.1	38.3	37.4	37.9	38.9	40.1	45.0	45.4	44.5	42.8	38.7
16.0	17.8	.44.6	42.1	.41.5	41.1	42.6	43.5	43.3	49.6	50.7	49.5	46.2	42.8
.5	18.3	50.8	46.5	.48.0	46.4	46.3	46.9	50.0	55.1	55.5	53.4	50.1	48.2
17.0	18.9	55.8	50.6	.52.8	52.2	51.5	.51.5	55.9	50.0	61.5	60.9	56.2	53.4
.5	19.4	60.6	56.1	.53.5	56.3	.58.9	.58.3	.62.1	67.4	65.8	62.3	60.3	58.8
18.0	20.0	65.6	61.6	.66.5	.64.6	.62.7	.60.8	.65.0	.72.6	.73.6	73.1	.68.6	65.8
.5	20.5	74.0	66.1	.74.0	.68.0	.63.3	.66.8	.73.0	80.3	.83.0	.79.7	.78.5	72.6
19.0	21.1	80.3	.73.5	—	.77.0	.66.0	.72.0	.79.0	—	.83.0	.83.8	.79.0	.79.7
.5	21.6	.83.2	—	—	—	—	—	—	.91.5	—	.90.4	.100.0	.88.0
20.0	22.2	.92.0	—	.97.0	100.0	—	—	—	—	—	.101.3	—	—

Les moyennes de moins de 15 sardines sont marquées avec.

51.22 ± 0.025. Quoique les différences entre les moyennes mensuelles à Leixões et à Lisbonne ne soient pas statistiquement significatives, mois par mois, la différence entre les deux moyennes annuelles, au contraire, semble montrer une différence réelle. D'autre part,

en comparant la marche de la variation des moyennes mensuelles à Leixões et à Lisbonne, il semble y avoir un certain parallélisme entre les oscillations de la valeur à Lisbonne et celles de Leixões le mois après. Toutefois, étant donné le nombre réduit de ces moyennes

Tableau 6.

Fréquence du nombre de vertèbres:

En % et par mois.

a) Leixões.

Mois	No. échan.	49	50	51	52	53	N	M	±	Fl. M	σ
I	3	0.2	6.1	65.9	27.0	0.8	522	51.22	±	0.08	0.57
II	3	0.2	6.5	59.5	31.1	2.7	599	51.30	±	0.09	0.63
III	—	—	—	—	—	—	—	—	—	—	—
IV	1	—	5.5	59.3	32.7	2.5	199	51.32	±	0.15	0.62
V	3	0.2	5.2	58.1	34.3	2.2	597	51.33	±	0.08	0.62
VI	4	—	6.0	60.2	31.5	2.3	799	51.30	±	0.07	0.60
VII	4	0.3	6.8	57.9	33.5	1.5	796	51.29	±	0.07	0.62
VIII	5	0.1	6.3	57.2	35.1	1.3	999	51.31	±	0.07	0.61
IX	4	0.1	3.8	58.0	36.3	1.8	800	51.36	±	0.07	0.59
X	4	—	4.3	52.0	41.3	2.4	800	51.42	±	0.07	0.61
XI	4	—	4.5	55.4	38.0	2.1	800	51.38	±	0.07	0.61
XII	4	—	4.3	55.4	38.0	2.3	800	51.38	±	0.07	0.60
	39	0.1	5.3	57.7	35.0	1.9	7,711	51.33	±	0.023	0.61

b) Lisbonne.

Mois	No. échan.	49	50	51	52	53	N	M	±	Fl. M	σ
I	4	—	8.1	60.6	30.5	0.8	505	51.24	±	0.09	0.60
II	4	—	8.7	66.4	24.5	0.4	491	51.17	±	0.09	0.57
III	2	—	8.8	57.6	33.6	—	205	51.25	±	0.14	0.60
IV	4	0.2	7.3	64.0	27.5	1.0	400	51.22	±	0.10	0.59
V	4	0.2	7.8	65.0	25.5	1.5	400	51.20	±	0.10	0.60
VI	4	—	9.2	64.3	25.0	1.5	400	51.19	±	0.10	0.61
VII	7	0.1	7.7	63.5	27.4	1.3	712	51.22	±	0.08	0.60
VIII	6	—	5.9	62.8	31.1	0.2	540	51.26	±	0.08	0.56
IX	5	—	6.9	60.3	32.1	0.7	539	51.27	±	0.09	0.59
X	7	—	8.0	64.9	26.1	1.0	798	51.20	±	0.07	0.58
XI	4	—	7.4	64.0	27.8	0.8	500	51.22	±	0.09	0.58
XII	4	0.1	7.1	65.7	26.4	0.7	746	51.20	±	0.07	0.57
	55	0.1	7.6	63.6	27.8	0.9	6,206	51.22	±	0.025	0.59

mensuelles, nous ne pouvons pas encore conclure que ce phénomène soit réel, car il se peut bien que cette coïncidence de variation soit simplement fortuite.

A. DE M. RAMALHO et collaborateurs.

La Ponte de la Sardine et de l'Ancchois en Eaux de Santander.

Pendant l'année 1952 les pêches périodiques du plancton commencées en 1949 ont été continuées dans la région de Santander pour déceler les périodes de ponte de la sardine et de l'ancchois.

En comparant les résultats obtenus en 1952 avec ceux des années précédentes, on observe, en ce qui concerne la sardine, une variation sensible, caractérisée par une ponte précoce et accomplie en une période très courte.

Au cours des années précédentes on n'a, en effet, observé la présence d'œufs que dans

la seconde quinzaine de Février ou au début de Mars, et la ponte s'étendit jusqu'à la fin de Juin; une seule fois la présence des œufs fut constatée exceptionnellement en Juillet. En 1952, par contre, les premiers œufs furent observés dans la première quinzaine de Février et leur présence fut également constatée durant tout le mois de Mars. Au cours des mois suivants on n'observa pas des nouvelles pontes.

On doit souligner le fait constaté au cours des pêches du 12 Février dans des eaux à 10.5°C. et $S^{0/00} = 35.01$, — où on put observer la présence d'œufs pour la première fois — que ceux-ci étaient morts dans la proportion de 80 %. Le même phénomène fut observé dans une ponte isolée constatée le 18 Décembre 1951, dans des eaux à 13.2°C. et $S^{0/00} = 35.58$, et puis encore, dans une autre pêche, dans l'année courante 1953, le 29 Janvier, dans des eaux à 11.2°C. et $S^{0/00} = 35.23$.

La présence d'œufs parasités n'a pas été signalée.

En ce qui concerne l'anchois, la ponte s'est étendue depuis la seconde quinzaine de Mars jusqu'à la mi-Août, résultat qui correspond avec les observations des années antérieures.

Au point de vue de température, la présence des œufs de la sardine fut constatée dans des eaux de 10.5° (minima) à 13° (maxima), et celle des œufs de l'anchois dans des eaux de 13° à 21° C.

JUAN CUESTA

THONIDÉS

Le Germon (*Germo alalunga* GMELIN).

Les Conditions de Milieu sur les Pêcheries de Germon en Juin 1952.

Au cours du mois de Juin 1952, la prospection du secteur compris entre 40° et 47° de Lat. N. et s'étendant jusqu'au 17ème méridien fut effectuée par deux navires («Patron Couvelard» et «André Rolland») armés pour la pêche du germon (*G. alalunga*).

200 milles
W. Cap Finisterre

La Rochelle

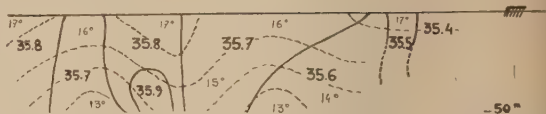


Figure 4. Section hydrologique, du large de La Rochelle à 200 milles dans l'ouest du Cap Finisterre.

Des observations hydrologiques furent effectuées en surface et à 50 m. de profondeur. L'augmentation rapide de la température en surface au cours du mois ne nous a pas permis de tracer une carte des températures en surface; mais la distribution des salinités a pu être établie, celles-ci variant de 35.4 à $35.9 \text{ }^{\circ}/_{\text{00}}$.

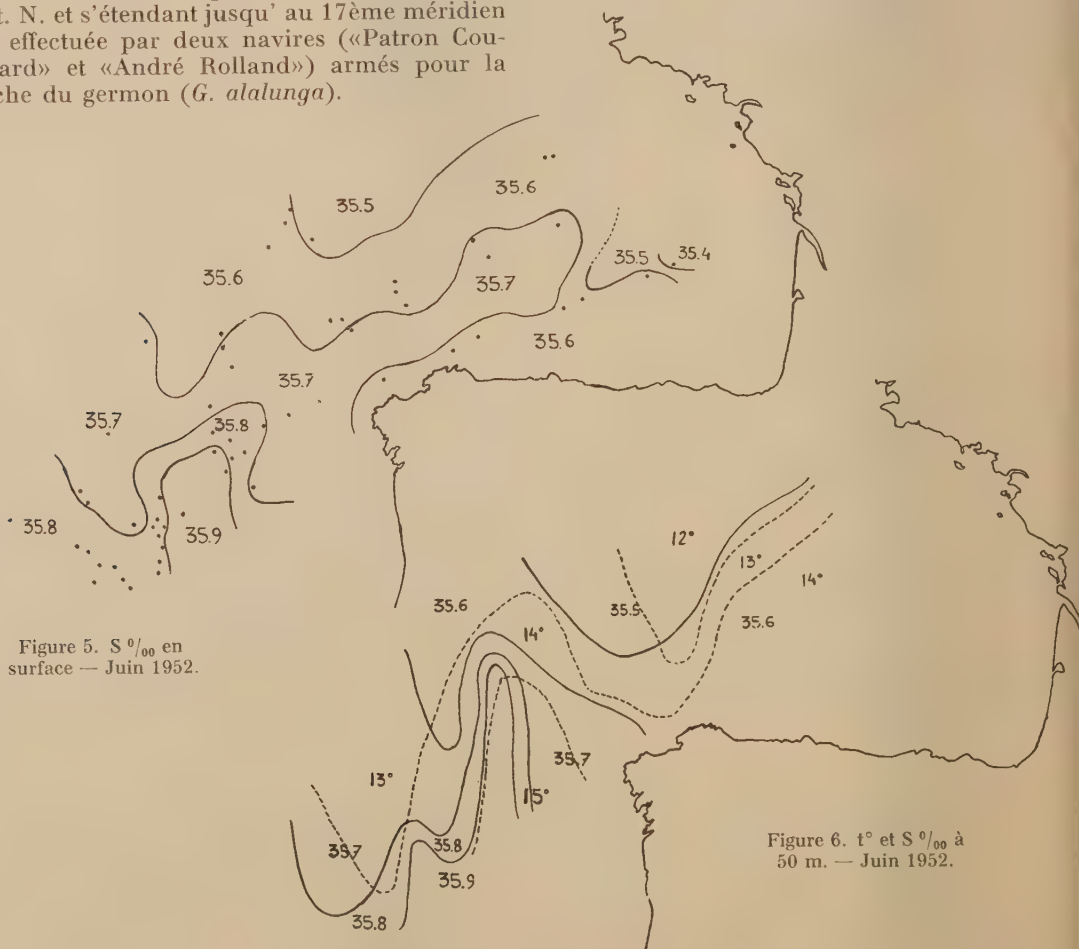


Figure 5. $S \text{ }^{\circ}/_{\text{00}}$ en surface — Juin 1952.

Figure 6. t° et $S \text{ }^{\circ}/_{\text{00}}$ à 50 m. — Juin 1952.

A 50 m., la situation est beaucoup plus stable et les températures et salinités ont pu être portées sur une même carte. Les données ainsi obtenues sont dans l'ensemble conformes à ce que nous connaissons de l'hydrologie de ces régions. On y notera : —

1. la présence du seuil froid formé par une masse d'eaux à 12° à 50 m., dont la salinité n'est que de 35.5 ‰ et qui barre l'entrée nord du Golfe de Gascogne;

2. l'infiltration des eaux atlantiques à 35.7 ‰ dans les couches superficielles de la partie sud du Golfe;

3. une avancée transgressive à 35.9 ‰ en surface à 180 milles environ au large de la côte ouest de la péninsule ibérique et dont l'action se fait sentir en profondeur jusqu'au nord de la latitude du Cap Finisterre.

Il est enfin à noter que les salinités observées au cours du mois de Juin 1952 sont de 0.1 à 0.3 ‰ supérieures à celles obtenues en 1922 lors d'une croisière dans le même secteur¹⁾. Les températures sont également dans

¹⁾ Notes et Mém. Off. Sc. Tech. Pêches. Mar. Paris no. 17. 1922.

l'ensemble légèrement supérieures à la moyenne des années 1900—37.

Les lieux de pêche découverts et signalés par radio aux pêcheurs se situaient dans l'axe transgressif à 35.9 ‰ de salinité et également le long de la zone de contact des eaux à 13 et 14° de profondeur.

J. LE DANTEC et R. LETACONNOUX

Plancton capturé au large des Côtes de la Péninsule Ibérique (sur les Pêcheries de Germon) — Juin 1952.

Au cours des sorties effectuées par le personnel de l'Office Scientifique et Technique des Pêches à bord du navire océanographique «Président Théodore Tissier» et des navires «Patron Couvelard» et «André Rolland» sur les pêcheries de germons (*Germo alalunga* GMELIN) des pêches de plancton ont été régulièrement faites dans le secteur compris entre 40° et 47° de Lat. N. et s'étendant de la côte jusqu'au 17ème méridien (voir carte, Figure 7).

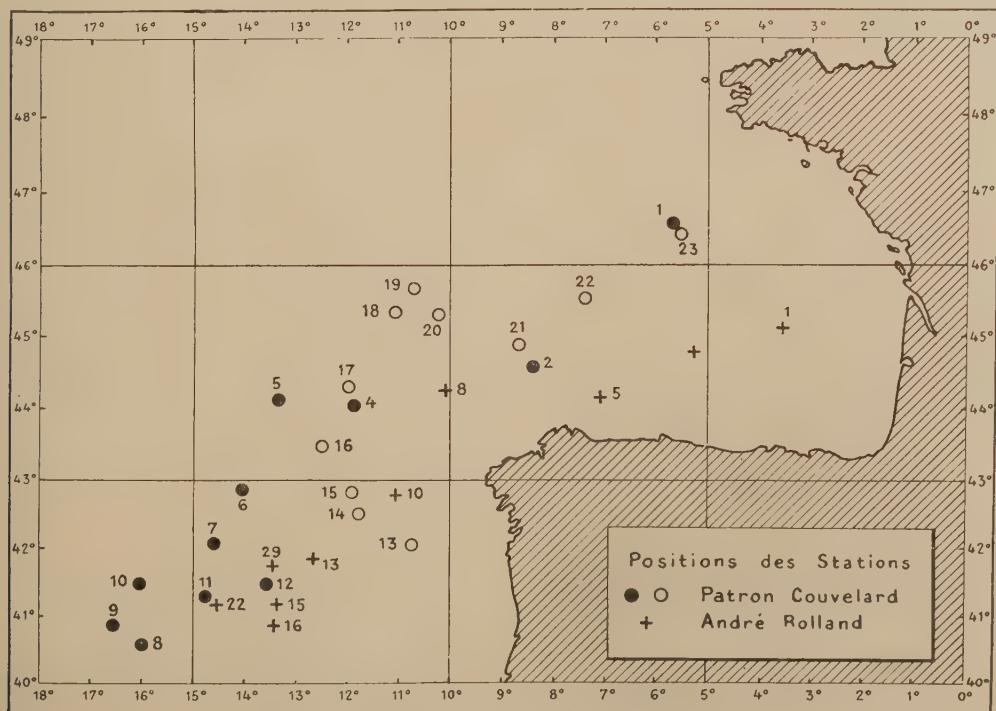


Figure 7. Carte des lieux de pêche du Germon.

Sur les lieux de pêche du thon, et à leurs limites deux zones distinctes peuvent être définies caractérisées par l'abondance des Salpes d'une part, et par celle de *Sagitta serratodentata* d'autre part.

En effet, dans les eaux les plus chaudes, au sud et vers l'ouest, des Salpes nombreuses sont largement réparties¹⁾ et représentées par :

- *Iasis zonaria* (P.C., Stn 11)
- *Salpa fusiformis* (A.R., Stn 13, 15)
- *Salpa maxima* (A.R., Stn 29) et
- *Thalia democratica* (A.R., Stn 15, 16, 29, P.C., Stn 10).

A la limite septentrionale des Salpes, *Sagitta serratodentata* domine quantitativement; elle est constamment présente aux points suivants: (P.C., Stn 10, 11, 14, 15, 16, 18, 19, 20, 21, 22; A.R., Stn 4, 5, 10, 15, 16). Elle voisine dans les eaux de salinité relativement plus basses avec *Doliolletta gegenbauri* (P.C., Stn 18, 20, 22).

La répartition des Méduses révèle l'extension septentrionale assez prononcée de plusieurs espèces, jusqu'au 45° de Lat. N. (Etude de RANSON), attribuée à l'avancée des eaux chaudes.

Aglaura hemistoma, forme des couches superficielles tropicales et subtropicales aux P.C. 18, 20 et 22 ainsi qu'à la station P.C. 16 où elle est la plus abondante.

Rhopalonema velatum, forme tout à fait océanique, est également présente aux stations 10 et 22.

Liriopse est reconnue une fois à la station 18 et *Cunina prolifera* est rare à la station 10.

Les Siphonophores: *Muggia atlantica* P.C. 21 et 22; *Eudoxoïdes spiralis* (P.C., 10, 15, 16, 18) et *Physophora* sp. (18) présentent la même extension.

La nappe d'eau transgressive transporte également toute une faune abondante de Copépodes pélagiques et d'autres Crustacés. Les formes tropicales de Copépodes sont localisées aux plus hautes températures :

- *Calanus gracilis* DANA (P.C., 11, 14, 19, A.R., 29)
- *Calocalanus plumosus* CLAUS (P.C., 14)
- *Calanus minor* CLAUS (P.C., 11, 15, 16)
- *Corycoeus speciosus* DANA (P.C., 11, 14)
- *Sapphirina angusta* DANA (P.C., 16)

¹⁾ Leur distribution s'étend jusqu'à l'île San Miguel et jusqu'au 37° Lat. N., ainsi que le révèle la campagne «Tissier» Juin 1952.

avec les formes tempérées qui s'échelonnent toutefois davantage vers le nord :

- *Centropages Bradyi* WHEELER (P.C., 14, 15, 16, 20, 22)
- *Centropages Chierchioe* GIESBRECHT (P.C., 20)
- *Centropages typicus* KRÖYER (P.C., 14, 15, 16, 20, 22; A.R., 1, 4, 5, 10)
- *Clausocalanus arcuicornis* DANA (P.C., 14, 19)
- *Oncea venusta* PHILIPPI (P.C., 11, 14, 15; A.R., 5, 10)
- *Pleuromamma abdominalis*, LUBBOCK (P.C., 11, 14)
- *Undeuchoea plumosa* LUBBOCK

et s'arrêtent à la limite des eaux froides et moins salées venant du nord où prennent place :

- *Pseudocalanus elongatus* BOECK (P.C., 19) et
- *Pleuromamma borealis* DAHL (P.C., 19, 22).

Le caractère purement océanique des eaux de la transgression est accusé par la présence d'espèces de Copépodes non néritiques à vaste distribution :

- *Calanus finmarchicus* GUNNER (P.C., 11, 14, 15, 16)
- *Clytemnestra scutellata* (P.C., 11)
- *Lubbockia aculeata* GIESB. (P.C., 11)
- *Microsetella rosea* DANA (P.C., 14)
- *Oithona helgolandica* CLAUS (A.R., 1)
- *Oncea mediterranea* CLAUS (P.C., 14, 15, 16, 19, A.R., 22)

- *Oncea subtilis* GIESB. (P.C., 11) et
- *Paracalanus parvus* (P.C., 14, 19; A.R., 15)

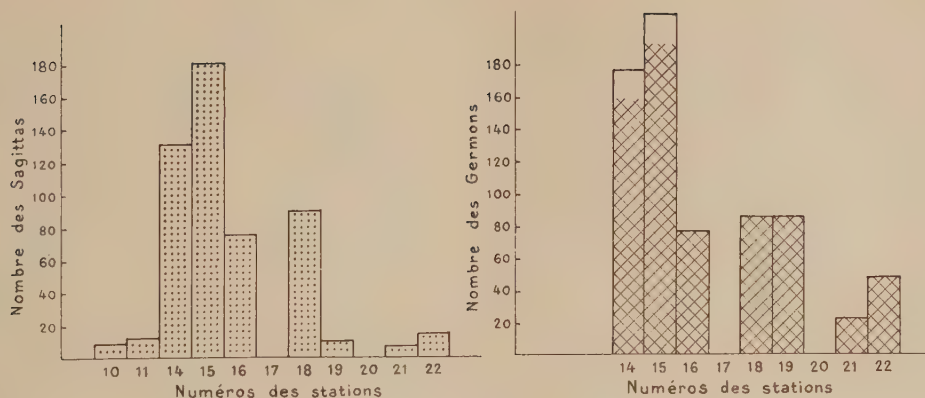
qui est indifféremment néritique ou océanique. Le Cladocère *Evadne spinifera*, pullule à l'est du 18° de Long.W. et au nord du 37° de Lat.N. dans la zone prospectée par le «Président Théodore Tissier». Il fut capturé par l'«André Rolland» aux stations 1, 4, 5 et 22 et par le «Patron Couvelard» aux stations 11, où il abonde, 20 et 21. Les zones où cette espèce est abondante bordent les lieux de pêche du thon.

Quatre espèces représentent les Amphipodes dans la zone étudiée :

- *Euthemisto compressa* (A.R., 10 et 16; P.C., 11)
- *Hyperia galba* (A.R., 29)
- *Phronima atlantica* (A.R., 13, 16, 22, 29; P.C., 10)
- *Platyscelus serratulus* (A.R., 10).

(Notons que *Phronima atlantica* est répandue dans les zones où les Salpes sont abondantes et particulièrement *Salpa fusiformis*).

La majeure partie des espèces mentionnées

Figure 8. *Sagitta serratodentata* «Patron Couvelard».

Germons «Patron Couvelard».

sont des formes tropicales, subtropicales ou tempérées, à peu près toutes grégaires, faisant normalement partie de la faune atlantique pélagique ou de celle des mers bordières de l'Europe. Quelques espèces seulement font partie de la faune froide de l'Atlantique Nord, les Euphausiacées, *Calanus finmarchicus* et *Pleuromamma borealis*.

Il semble probable que toutes ces espèces des mers chaudes et tempérées apparaissent, comme le germon, au large des côtes occidentales d'Europe avec les eaux atlantiques chaudes et salées qu'elles accompagnent dans leur mouvement de transgression ou de régression ainsi que l'a suggéré J. LE GALL.

L'extension plus ou moins étendue de ces formes tropicales, subtropicales ou tempérées a été étudiée par RUSSELL. Plus récemment les importants travaux de FRASER ont décrit l'apparition des formes «indicatrices» d'eaux chaudes (*S. fusiformis*, *Th. democratica*, *Doliolletta gegenbauri*, etc...) en provenance du sud-ouest au large de la côte Atlantique de l'Irlande et décrit leur trajet jusqu'au nord de la Mer du Nord.

Lors de sa migration trophique dans l'Atlantique Nord le germon, poisson vorace qui chasse tout ce qui se déplace, se nourrit du plancton abondant et de jeunes poissons qu'il trouve en surface. Plusieurs des espèces que le «Patron Couvelard» et l'«André Rolland» ont capturé au filet de soie sur les lieux de pêches ont été signalées par LEGENDRE dans «La Faune Pélagique de l'Atlantique recueillie dans les estomacs de germons». Ainsi: *Phronima atlantica*, *Iasis zonaria*, *Hyperia galba*, *Platyscelus serratus*, *Calanus finmarchicus*, *Euthe- misto compressa*. Cet auteur et W. BEEBE ne

mentionnent pas, dans le régime alimentaire, les Choetognathes que nous avons trouvé en abondance aux lieux des meilleures pêches du thon. Le graphique joint (Fig. 8) montre la corrélation entre le nombre des captures de *Germo alalunga* et de *Sagitta serratodentata*, espèce planctonique d'eaux chaudes et salées dont la distribution à l'entrée de la Manche et jusqu'au nord de la Mer du Nord semble avoir la même direction que celle des thons.

Une étude aussi complète que possible du plancton, pratiquée aux mêmes lieux pendant plusieurs années conduira sans doute à trouver des formes holoplanctoniques «indicatrices» dont la présence signalerait la possibilité de trouver des thons.

J. FLEURY

Le Germon dans le Golfe de Gascogne et en Mer Celtique.

I. Statistiques.

Les quantités de germons, ou thons blancs, (*Germo alalunga* Gm.) débarquées de Juin à Novembre 1952 dans les ports thoniers français se sont élevées à 12,640 tonnes, avec la répartition mensuelle suivante:

Années/ Mois	Mois	Juin	Juillet	Août	Sept.	Oct.	Nov.	Total
1952		122	2937	4583	3758	1243	—	12640
1951		9	3075	3884	3662	2331	75	13036
1950		6	4841	4078	1783	1752	128	12588
1949		4	4010	3775	3379	2427	6	13601
Moyenne								
1949-1952		35	3716	4080	3146	1938	52	12967

En comparant ces apports à ceux des années précédentes, on remarque que les apports relativement importants de Juin 1952 con-

firmement que la pêche du germon peut être commencée dès la première décade de Juin, en allant au-devant du poisson au large de la côte nord-ouest de la péninsule ibérique.

Après ce bon début en Juin, la pêche fut inférieure à la moyenne en Juillet; elle fut bonne en Août et en Septembre, pour tomber nettement au-dessous de la moyenne en Octobre, par suite de conditions atmosphériques défavorables. A la fin d'Octobre, la majorité des thoniers avait désarmé (Fig. 9).

Ces chiffres montrent encore que, dans une année normale, 30 % des apports annuels sont débarqués à la fin de Juillet, 60 % à la fin d'Août, 85 % à la fin de Septembre; 15 % des apports seulement n'étant effectués pendant les mois d'Octobre et de Novembre, (ceux-ci étant insignifiants pendant ce dernier mois). Pratiquement, le sort de la campagne de pêche du germon se trouve être réglé chaque année à la fin du mois de Septembre.

II. Conditions hydrologiques: les «Eaux à Thons».

Dans ce même volume des *Annales Biologiques* (voir l'exposé page 82), R. LETACONNOUX et J. LE DANTEC ont rapporté les résultats des observations qu'ils ont faites, en Juin 1952, sur les pêcheries de germons au large de la côte d'Espagne et à l'entrée du Golfe de Gascogne. Ces observations ont été complétées par celles de Mlle FLEURY sur le plancton récolté.

Les résultats des nombreuses observations, régulièrement faites chaque année depuis 1921 sur ces pêcheries, montrent que la définition des «Eaux à Thons» telle qu'elle a été établie par Ed. LE DANOIS et G. BELLOC en 1923, conserve toute sa valeur et se vérifie progressivement dans toutes les mers du monde où la présence du germon a été reconnue.

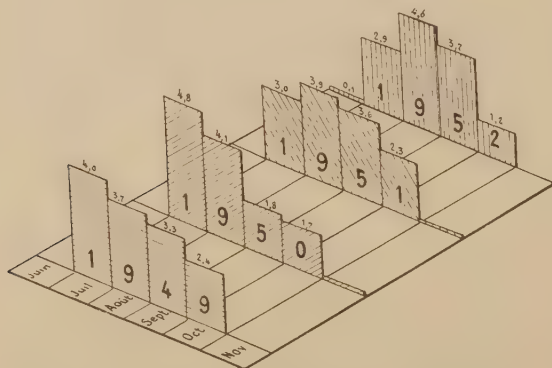


Figure 9. Répartition mensuelle d'après la taille au cours des années 1949 à 1952.

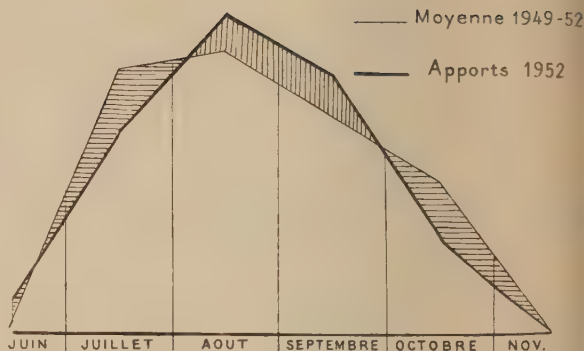


Figure 10. Répartition des apports en 1952 comparés à la moyenne 1949-1952.

«Le Germon fréquente en été les eaux superficielles dont la température à 50 mètres est supérieure à 14° C.»

Il se confirme ainsi que la température de l'eau doit être le facteur principal dans la distribution du germon dans l'Atlantique Nord. Les observations faites au cours de ces dernières années ont montré que les plus fortes captures se faisaient généralement dans les eaux superficielles relativement chaudes, variant de 14° à 22° suivant la latitude et le mois considérés et, particulièrement, dans celles d'une température allant de 16.5° à 19°.

Au facteur température se trouve également intimement lié le facteur salinité. Les observations faites depuis 1947 ont permis de constater et de vérifier que les germons se trouvaient toujours dans les eaux salées d'une salinité supérieure à 35.5 ‰.

Cette température et cette salinité élevées caractérisent les Eaux Atlantiques et définissent le domaine hydrologique normal du germon.

Le germon se déplace dans ce domaine avec les Eaux Atlantiques qu'il suit dans leur mouvement.

Mais, les dernières recherches ont prouvé aussi que c'est en bordure (sur les marches) de ce domaine, là où les Eaux Atlantiques viennent se heurter à la masse des Eaux Continentales qu'elles refoulent, que le germon est particulièrement abondant.

C'est, en effet, à la rencontre de ces deux domaines hydrologiques apportant chacun sa faune particulière, que le germon trouve la nourriture abondante nécessaire pour satisfaire sa voracité.

La recherche d'une nourriture abondante influe donc, comme la température et la salinité, sur sa distribution.

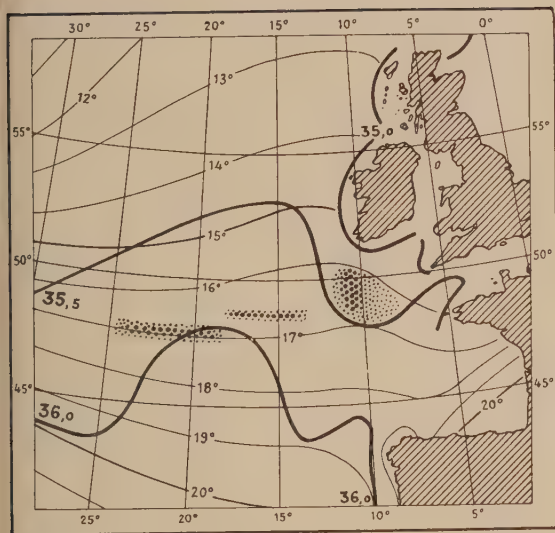


Figure 11. La présence du Germon au large du Plateau Continental Celte.

En l'absence de thermomètre, la couleur de l'eau reste un indice pour les pêcheurs. Les Eaux Atlantiques sont bleues; les Eaux Continentales sont vertes et, occasionnellement, bleu-vert. C'est dans les eaux bleues ou dans les eaux vertes à la *limite des eaux bleues*, que se feront les meilleures pêches.

Faisant route vers Terre-Neuve au début d'Août 1952, par 48°30 à 49° de Lat. N., le navire océanographique «Président Théodore Tissier» a capturé 73 germons jusqu'à 700 milles de la côte. Au-delà du 20° Long. W. Gr., bien que les conditions hydrologiques fussent favorables, aucun germon ne fut aperçu.

Au retour du navire, vers la mi-Septembre, par 47°15 de Lat. N., à l'est du 24° Long. W. Gr., à 800 milles de la côte, des germons étaient encore aperçus et pêchés. (Fig. 11).

On peut considérer que ces poissons se trouvaient à la limite occidentale de l'aire de distribution de l'espèce dans l'Atlantique Nord-Est. Cette première constatation demande à être confirmée.

III. Le rendement de la pêche au cours de la journée.

La pêche du germon à la ligne traînante se pratique uniquement de jour. Elle commence dès le lever du soleil qui, à cette époque de l'année et sur les lieux de pêche du Golfe de Gascogne et en Mer Celtique, se lève vers 5 heures du matin. Elle se termine pratiquement vers 20 heures quand le soleil se couche;

ce n'est qu'exceptionnellement qu'elle se prolonge au crépuscule.

Elle n'est pas uniforme pendant la journée; les captures sont plus nombreuses entre 8 et 10 heures quand le soleil est déjà haut sur l'horizon; puis, entre 16 et 18 heures quand il s'incline sur l'horizon, après une diminution nettement marquée aux heures méridiennes (entre 11 et 15 heures).

Les observations répétées faites par les collaborateurs de l'Office Scientifique et Technique des Pêches Maritimes sur les lieux de pêche du germon ont permis d'établir, indépendamment de tous autres facteurs ayant pu affecter le rendement de la pêche, le pourcentage de germons capturés par période de deux heures, depuis 4 heures du matin jusqu'à 22 heures :

Heures	Poissons capturés	Heures	Poissons capturés	Heures	Poissons capturés
de 4 à 6 h.	4 %	de 10 à 12 h.	12 %	de 16 à 18 h.	22 %
» 6 » 8 »	10 »	» 12 » 14 »	9 »	» 18 » 20 »	16 »
» 8 » 10 »	16 »	» 14 » 16 »	8 »	» 20 » 22 »	3 »

Résultats ramenés au chiffre entier le plus voisin (Fig. 12).

La pénétration de la lumière dans l'eau suivant son incidence, son influence sur la distribution en profondeur des animaux dont se nourrit le germon ne doivent pas être étrangères à ce ralentissement de la pêche constaté aux heures méridiennes.

IV. La détection électronique des bancs de germons.

Des essais répétés de détection électronique des bancs de germons effectués à l'aide des sondeurs à écho à bord du navire de recherches «Président Théodore Tissier» et des thonniers sur les lieux de pêche n'ont pas donné de résultats probants.

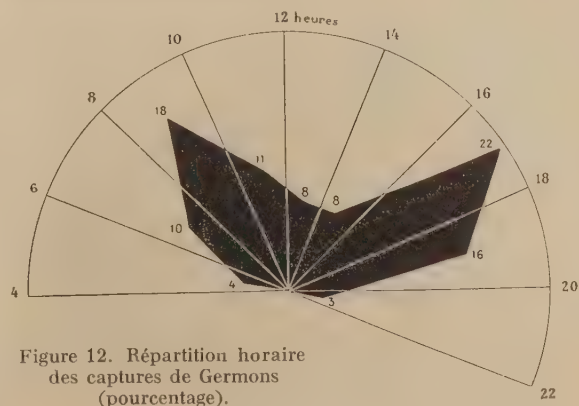


Figure 12. Répartition horaire des captures de Germons (pourcentage).

Cependant, des inscriptions très nettes ont été observées à bord du thonier «Patron Couvelard» de Concarneau opérant sur une pêcherie. La pêche était bonne là où l'écho d'un banc se manifestait en profondeur. Mais, d'après R. LETACONNOUX, qui participait à ces essais, cet écho était vraisemblablement dû à la présence d'un banc important de plancton ou de petits poissons qui avaient attiré les germons dans ces parages plutôt qu'à ces poissons eux-mêmes.

V. Mensurations.

Diverses circonstances ne nous ont pas permis de procéder régulièrement au cours de la saison de pêche de 1952, aux nombreuses mensurations habituellement effectuées sur les lieux de pêche ou au débarquement du poisson.

Néanmoins, les mensurations faites en Juin, puis en Août, sur près de 2,000 germons confirment la distribution par groupes de taille (et d'âge) précédemment établie (voir *Annales Biologiques* 1949—1950—1951).

Le groupe II, relativement nombreux en Juin, avait sensiblement diminué en importance au mois d'Août. Le groupe III dominait en Juin et en Août comme de coutume et le groupe IV, déjà présent en Juin, paraissait avoir pris une importance exceptionnelle en Août. L'importance relative de ces deux groupes en 1952 peut expliquer le rendement supérieur à la moyenne de la pêche du germon pendant le mois de Septembre.

J. LE GALL

Merlu.

Preliminary Note on the Scottish Hake Fishery.

At various times before and since the second world war anxiety has been expressed at the declining catches of hake by English vessels from the main centres of distribution lying to the south and west of Ireland. Following the fishing out of the war-time accumulation of stocks on these grounds the landings from 1948 onwards fell below the quantity landed by English vessels from the west of Scotland grounds which have continued to yield satisfactory results. At the same time landings of hake in Scotland showed a marked increase during the second world war and more particularly in the post-war years.

Scottish hake statistics may be conveniently considered by grouping the years and landings as follows:—

Period	Minimum Catch in Cwts.	Year	Maximum Catch in Cwts.	Year	Average in Cwts.
1904—1914 ...	13,372	1909	34,220	1905	21,465
1915—1919 ...	3,471	1917	10,153	1919	6,275
1920—1939 ...	17,344	1934	42,738	1924	30,931
1940—1946 ...	41,328	1945	55,712	1941	49,233
1947—1951 ...	81,948	1948	106,801	1950	96,195

These figures show a rapid rise in the landings of hake in Scotland. Another interesting feature is the heavy landings during the second world war as compared with those during the first world war. This may be due partly to the growth of the seine-net fishery since its introduction to Scotland in 1923.

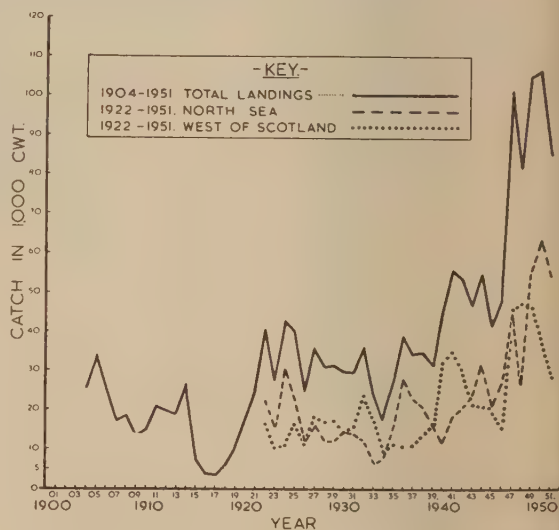


Figure 13. Landings of hake in Scotland by British vessels.

The total Scottish landings from 1904 onwards are illustrated in Figure 13 which also shows separately the quantities obtained from the North Sea (E. of 4°W. and S. of 62°N.) and the west of Scotland grounds, the two sea regions from which the Scottish catch is derived. It will be observed that high landings from the North Sea are generally accompanied by relatively poor landings from the west of Scotland and vice versa.

Three methods of fishing contribute to the Scottish hake catch. In the North Sea the otter trawl is the chief means of capture with the seine-net providing a smaller but increasing

quantity yearly. Line-fishing accounts for insignificant quantities in this region.

Off the west of Scotland, where trawling provides a smaller amount of hake than in the North Sea, seine-net catches have been steadily increasing since the war with the result that the total by this means now considerably exceeds the yield from trawling. Line-fishing in this region is of greater importance than in the North Sea and from time to time this method has provided a higher annual total than one or both of the other two methods.

Although English and Scottish vessels fish the west of Scotland region, operations by the two nationalities are generally carried out on separate grounds. Whereas English trawlers fish over the greater part of the west coast grounds, including the Minch and the St. Kilda area, Scottish trawlers fish mainly on grounds to the north of Scotland (W. of 4°W.), to the north of the Butt of Lewis and occasionally in the Northern Minch and round the Flannans. Scottish seiners so far have been confined to the same grounds as Scottish

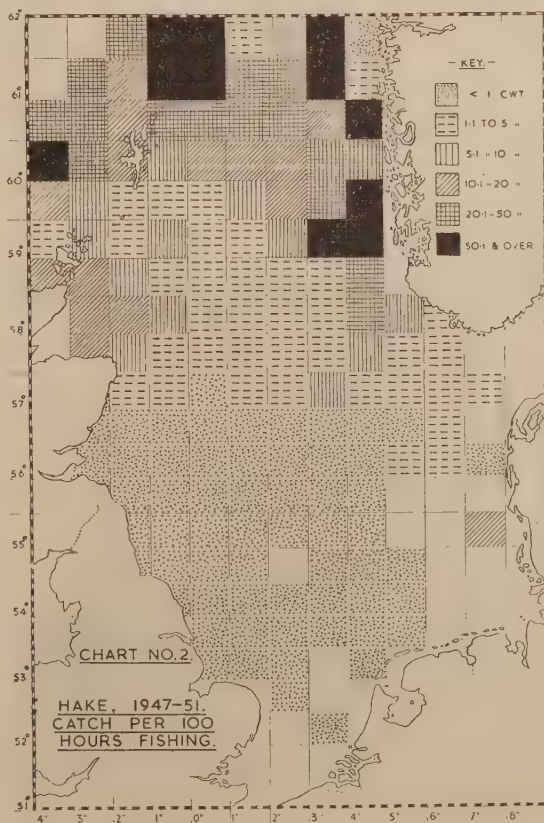
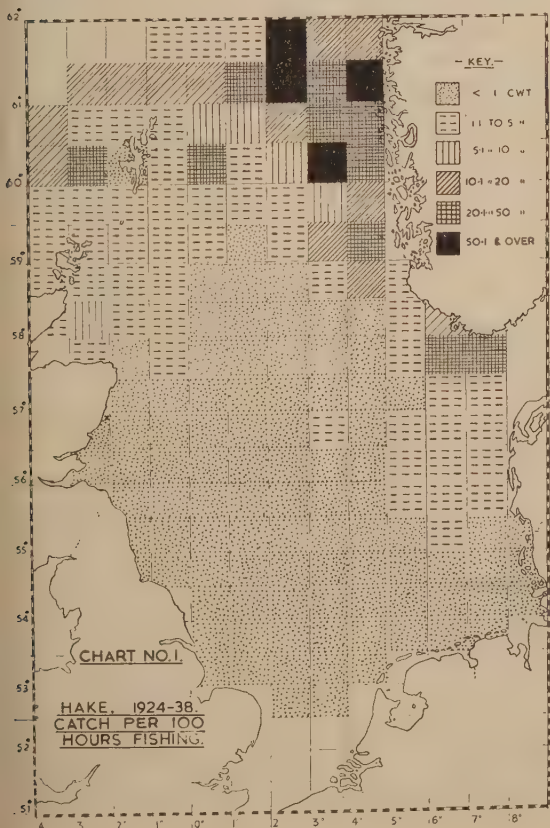
trawlers and to inshore areas southwards to and including the Firth of Clyde.

For a more detailed study of the hake statistics attention must necessarily be confined to trawler landings from the North Sea (combining both English and Scottish catches).

During the inter-war period 1923-1938 the yearly average catch per 100 hours' trawling amounted to 1—2 cwts. On a monthly basis the average for the same unit of fishing time ranged from 0.6 cwts. in January to 2.2 cwts. in June with the main season lasting from March to August.

In the post-war period the average catch per 100 hours' trawling by British vessels increased to range from a minimum of 2.3 cwts. in 1948 to a maximum of 5.1 cwts. in 1950. The corresponding average monthly figures for the same period provided a maximum of 17.2 cwts. in May, while the main season shifted slightly to extend from April to September.

The average British North Sea total landing of hake for 1924-1938 was some 40,000 cwts.



and for 1946-1950 about 50,000 cwts. England's average contribution was some 23,600 for the period 1924-1938, declining to 6,500 cwts. for 1946-1950, so that the Scottish averages rose from about 16,000 cwts. to over 40,000 cwts. This increase is to be ascribed principally to the Scottish trawler catches since the seine-net yield is still relatively low.

In order to study the distribution of the hake within the North Sea Charts I and II have been drawn to show the average trawl catch per 100 hours' fishing in each statistical square for the periods 1924-1938 and 1947-1951 respectively. The earlier period of 15 years was subdivided into five-yearly periods, but as no significant difference was noted in the distribution for the three periods it was decided to combine the 15 years.

The charts show a marked change in the distribution. During the inter-war period hake were caught mainly in the deep water north of the Viking Bank and along the Norwegian Deep to the southern point of Norway. A definite movement of hake could be traced annually in the first half of the year which generally reached the south of Norway in June or July. Thereafter a dispersal took place south-westwards to cover the area from the Danish coast to the Little Fisher Bank. A minor movement of hake during the summer brought them to the area extending from the Moray Firth to the western border of the Fladen, presumably from the western side of the Orkneys and Shetland.

Chart II shows a marked difference for the post-war period. Although the concentration running southwards along the Norwegian Deep is still prominent it does not, according to British landings, extend to the south of Norway and shows less evidence of the expansion within the central North Sea observed during 1924-38.

On the other hand a dense concentration to the north and west of Shetland is now being located mainly in the spring and summer. During the summer and early autumn, hake shoals have also been penetrating the Moray Firth and grounds eastwards to the western edge of the Fladen in greater strength than previously experienced. A southerly extension of these latter shoals to the area immediately east of the Aberdeenshire coast has also been providing substantial quantities of hake in an area which previously produced small quantities.

Such apparent changes in the intensity and distribution of the hake shoals might arise in one or more of several ways, including (a) changes in the efficiency of fishing gear, (b) changes in fishing practice, and (c) changes in the movement and distribution of the hake.

The gear used by Scottish trawlers is the V.D. trawl and, except for minor modifications, it is the same as was used in the latter half of the inter-war period. There are therefore no grounds for attributing the changed and improved hake catches to this cause. As regards changes in fishing practice, it is certain that some skippers now fish deliberately for hake, whereas formerly the capture of this species was more incidental to the search for other varieties more frequently caught by Scottish vessels. The number of vessels deliberately seeking hake, however, is comparatively small, so that this practice has probably had little appreciable effect on the landings in the course of a year.

A more probable contribution to the increased landings arises from the growing habit of trawlers to fish in fleets following the spread of radio reports on the presence of shoals. This practice would no doubt be particularly effective in the case of a fast moving migratory species such as the hake in its annual invasion of the North Sea. A shoal of hake would be more readily and rapidly exploited under present day conditions than in the past when trawlers tended to fish individually and when less reliance was placed on information received by radio. On the other hand, the grounds lying immediately to the eastward of the Moray Firth and of the Aberdeenshire coast have at all times been heavily fished by Scottish vessels, so that it is almost inconceivable that in the period between the wars hake shoals were present on these grounds without being located and exploited.

The most likely explanation of the increased landings and spatial changes here and elsewhere would appear to lie in changes in the movement and distribution of the species. It has long been recognised that the hake fishery in the North Sea is dependent on the annual invasion of the area by shoals from the deep water to the north and west of Shetland and Orkney. This incursion is probably largely for feeding purposes but it is certain from the presence of larvae in the plankton and of small numbers of the youngest bottom stages that some spawning does take place within

the North Sea. At the same time comparatively few ripe and spawning fish are taken in the area and market landings include a relatively small proportion of small fish. The evidence from the increased hake catches since the second world war (apparently still increasing)

therefore suggest a considerably greater movement of shoals into the North Sea and adjacent waters and a wider distribution of the species in areas where previously it had been but moderately represented.

B. B. RAE

MOLLUSQUES

Etat de la Population de Coquilles
Saint-Jacques (*Pecten maximus* L.) en
Rade de Brest en 1952.

L'étude du stock de coquilles St-Jacques de la rade de Brest a été faite, comme les années précédentes, par la méthode habituelle des mensurations rapportées au centimètre inférieur.

Le Tableau 7, indiquant la répartition suivant leur taille des échantillons prélevés en Janvier, Avril, Juin, Juillet, Octobre et Novembre, montre que la taille *moyenne* diminue de Janvier à Avril, puis augmente d'Avril à Novembre.

La moyenne générale (8.73 cm.) est très légèrement supérieure à celle observée en

Tableau 7. Répartition suivant la Taille.

(Les modes sont en chiffres gras.)

Mois	Janvier	Avril	Juin	Juillet	Octobre	Nov.
cm.	N	%	N	%	N	%
2	—	—	2 0.9	—	—	—
3	—	—	1 0.4	—	4 0.4	—
4	—	—	2 0.9	8 3.5	19 2.1	1 0.2
5	7 4.4	9 3.9	1 0.4	18 2.0	2 0.4	—
6	5 3.1	21 9.2	2 0.9	13 1.4	9 2.0	1 0.5
7	16 10.0	20 8.8	32 12.5	136 15.2	31 6.8	3 1.7
8	94 59.2	95 41.9	96 40.1	273 30.4	221 48.7	82 43.7
9	28 17.7	61 27.0	77 32.1	318 35.4	168 37.1	87 46.9
10	7 4.4	16 7.0	21 8.8	108 12.0	21 4.6	10 5.5
11	1 0.6	—	4 1.7	10 1.1	1 0.2	3 1.7
12	1 0.6	—	—	—	—	—
N	159	227	241	899	454	186
cm.	8.01	7.90	8.24	8.28	8.33	8.59
Tail.	+ 0.50	+ 0.50	+ 0.50	+ 0.50	+ 0.50	+ 0.50
moy.	= 8.51	= 8.40	= 8.74	= 8.78	= 8.85	= 9.09

Moyenne pour l'année: 8.73 cm., N = 2166.

Tableau 8. Croissance suivant la Taille au
Cours de l'Année 1952.

(Le nombre des individus examinés est donné après le chiffre exprimant la croissance en millimètres.)

Mois	Avril	Juin	Juillet	Novembre
Taille	Crois-	Crois-	Crois-	Crois-
(en cm.)	sance	sance	sance	sance
4	—	26	7	2
5	6	25	1	35
6	3.8	5	20	2
7	5.8	5	16	19
8	2.2	27	9	86
9	1.5	28	6	63
10	—	—	4	16
11	—	—	—	3

1951 (8.61 cm.), elle-même déjà en forte diminution par rapport à celle de 1950 (9.19 cm.) et de 1949 (9.41 cm.) (J. LE GALL).

Croissance.

Le Tableau 8 indique, par *groupes de tailles*, l'augmentation de la taille depuis le dernier anneau jusqu'aux mois d'Avril, Juin, Juillet et Novembre.

Tableau 9. Croissance suivant le Groupe d'Age
au Cours de l'Année 1952.

Mois	Juillet	Novembre
Groupes	Croissance	Croissance
(anneaux)	mm.	mm.
I	32.5	5
II	21.5	84
III	10.0	110
IV	5.1	12
V	3.0	5
VI	2.5	3

Le Tableau 9 indique les croissances observées par *groupes de tailles* aux mois de Juillet et de Novembre.

La croissance s'arrête pratiquement en Novembre. Les chiffres obtenus pour le groupe I (à un anneau d'hiver) correspondent à la différence $L_2 - L_1$; ceux obtenus pour le groupe II: à la différence $L_3 - L_2$, etc...

Les observations ont été suffisamment nom-

breuses sur les groupes I et II pour pouvoir en tirer des conclusions valables.

La croissance a été forte en 1952, bien que la moyenne générale soit restée faible.

La diminution de la taille moyenne constatée depuis quelques années doit être une conséquence du développement de la pêche et de sa mécanisation.

L. FAURE

North Sea.

INTRODUCTION

Once again it is possible to review hydrographical and biological records for the North Sea as a whole: this time with the addition of contributions from the German laboratories, which have already assisted in the valuable co-operative work being undertaken in the Southern North Sea. Information about shellfish and herring will be found in the appropriate sections.

For 1952, contributions have been received from:—

Denmark:

K. P. ANDERSEN	A. J. C. JENSEN
J. SMED	H. THOMSEN
E. URSIN	

England:

J. A. GULLAND	A. C. SIMPSON
R. S. WIMPENNY	

Germany:

H. J. AURICH	G. BÖHNECKE
A. BÜCKMANN	A. KOTTHAUS
P. MEYER-WAARDEN	E. ZIEGELMEIER

Norway:

G. DANNEVIG

Scotland:

R. E. CRAIG	R. W. ELLIS
J. H. FRASER	R. JOHNSTON
R. JONES	J. M. LAMONT
T. LOVEGROVE	W. MAIN
B. B. RAE	K. M. RAE
J. B. TAIT	E. WILSON

A. Environment.

Further information on long-term temperature trends in the north-western North Sea illustrate the marked positive anomaly during the years since 1932. There are indications, however, that the temperatures may have culminated during the forties.

The strongly oceanic influence in the northern North Sea, as recorded at the end of 1951 by drift-bottle returns and temperature/salinity data, gradually weakened during the first quarter of 1952 and reached a minimum strength in May. Subsequently, a summer maximum was attained, probably in August,

followed by a slight recession, until yet another increase was recorded as beginning in December.

The more extensive recording of chemical conditions in the area and its approaches, particularly phosphate and oxygen values, now enables a picture to be drawn of the conditions near the surface in the winter and the general changes leading to those in the summer. The highest free phosphate values were found in the winter around Faroe, decreasing more or less steadily south-westwards and towards the central North Sea. The lowest surface values were found in the coastal waters. By July, the lowest values were found in the central northern North Sea and some coastal waters: whilst considerable depletion had occurred elsewhere, the surface values around Faroe and in the approaches, for example, remained relatively high. Future variations on this general theme, which particularly characterized the year 1952, should prove of interest.

Records from the Danish lightvessel "Vyl" suggest rather more saline and warmer conditions at both surface and bottom during 1952 than usual, particularly in the winter (although the summer temperatures were lower than usual). Routine sections taken in the "Bløden-grund" area draw attention to the low bottom temperatures to be found there in contrast, for example, with the area to the north of the Dogger Bank.

Very detailed investigations with self-recording current meters in the south-western North Sea have provided a quasi-synoptical picture of the conditions on two occasions. The four characteristic water masses moved considerably between 26. February and 19. March, when there was a drift north-eastward towards the Helgoland Bight; all the evidence points to considerable stratification with horizontal mixing as the tidal phases changed. As there is some reason to suppose that such conditions may be more or less typical, the associated onshore and offshore movements must be important in transporting floating particles; near the bottom, these movements will tend to transport fish fry and sand towards the continental coast, (see also drift of plaice larvae reviewed below). Associated investigations

point to the waste waters from the River Thames as contributing to the high fish yields in the south-western North Sea.

The Continuous Plankton Recorder survey and the general Scottish plankton collections show the general and special features characterizing 1952. One feature is the more or less steady increase in the numbers of the larger *Metridia lucens* in the oceanic continuous records since 1948-49. General results suggest a moderately good penetration into the North Sea of water from the continental shelf west of Orkney. Once again, the distinction between the different plankton communities off the edge of the continental shelf was quite evident, as also those of the waters entering the North Sea via the north of Shetland and the Orkney passage. In a separate report, special hydro-biological surveys of the waters in the north-western North Sea are described. Estimates of plankton fat-content and dry weight off the east coast of England for 1950-52 (continuing an earlier series) suggest 1952 to have been outstanding, particularly as regards dry weight. A new feature (for 1951-52) is the inclusion of estimates of flagellates and small algae at certain stations.

B. Fish.

Young Fish and Fish Eggs: Eggs of *Engraulis encrasicolus* were relatively common off the Dutch/German coasts in 1948-1952 as compared with pre-war years. Among other changes recorded, spawning of *Clupea pilchardus* is now occurring in the southern North Sea, along its eastern edge. Other records of eggs and young fish show larger numbers of sole, horse mackerel, and sprat than before.

The drift of plaice eggs of comparable stages in the Southern Bight has been investigated over the period February-March, and can be compared in due course with the hydrographical data reviewed above. Whilst some patches appeared to undergo little movement, others must have drifted at the rate of some three miles per day.

Haddock: The usual Scottish analyses show that the 1945 and 1947 broods are now of little importance, the bulk of the catches landed by British steam trawlers being provided by the 1948-50 year-classes. There was a decrease in the weight of haddock landed by these trawlers during 1952 from the area south of 57°30'N., whilst yields obtained to the north of this line showed little difference.

Whiting: Tables are presented showing the British steam trawler data for 1952 corresponding with those of the haddock. They show no major trends, when compared with previous tables, over the period 1947-52.

Plaice: British steam trawler landings in 1952 are reviewed and show an interesting increase in the proportion of medium sized fish, particularly from the Silver Pits region.

Many Danish cutters have taken part in herring fishing rather than plaice during 1952, and this is considered to be responsible for some improvement in the catch per landing from grounds to the east of the Dogger Bank. Research vessel data suggest a large decline in the availability of young plaice in the Horn's Reef area, with which the increased growth-rate is said to be associated.

The 1951 year-class in the Danish Waddensea appears to have been a very poor one and, correspondingly, that in the German Waddensea was poor when compared with that of 1950. Similarly, inshore investigations along the Scottish east coast suggest that the 1951 year-class was a poorer one than that of 1950, although, in deeper waters, the III, IV and V-groups are dominant. By contrast, German investigations in the Helgoland Bight during 1952 showed the dominance of age-groups II and III, while group V (1947) was still playing an important part, particularly in the commercial fishery.

Sole and Dab: Data are recorded of the numbers and size of 0-group sole in the German Waddensea, for which 1950 had also been a good year, and of the stock of dab in the southern Horn's Reef area, where the density in recent years proved to be less than that in the 'thirties.

Mackerel: The tagging experiments begun in 1951 (see Ann. Biol., **8**, p. 114) have produced further recoveries of tagged fish in 1952.

Rare Fishes: Records were numerous again in 1952, but they differed from 1951 in a number of ways.

Food of Fish: Important additions to the North Sea "Annales" include records from the Helgoland Bight and Elbe estuary of the occurrence and abundance of bottom-living forms of potential value as food for commercial fish, and as actually eaten by non-commercial ("incidental") fish. Attention is drawn to the ecological and ultimately commercial significance of the latter.

C. E. LUCAS

ENVIRONMENT

Hydrography.

Monthly Anomalies of the Surface Temperature in an Area off the Eastern Coast of Scotland in the Period 1876-1952.

In *Annales Biologiques*, 4, a graphical presentation of the monthly anomalies of surface temperature in the area F (56° — 60° N., 0° — 3° W.; see Fig. 1) during the period 1876-1939, together with the anomalies for the years 1945-47, were given.



Figure 1. Location of area.

In carrying this work up to date it was thought preferable to publish the anomalies for the whole period, as for most purposes it will probably be more useful to have the anomalies themselves than their graphical presentation alone. Table 1 gives, therefore, for each month in the period 1876-1952, the mean anomaly (Δ) and the number (n) of observations in the month in question. As

standard values were used the grand monthly means for 1° -squares over the period 1876-1915 published by RYDER. For further details the reader is referred to the article mentioned above.

For each year the monthly anomalies are averaged in the last column of Table 1. These averages are plotted in Figure 2. The preponderance of positive anomalies in the years from 1932 onwards is conspicuous. It seems, however, that the temperatures have culminated in the forties.

JENS SMED

Northern North Sea and Approaches.

General.

The scope of hydrographic work undertaken by Scottish research vessels during 1952 over the usual regions from Scotland to Iceland and the northern North Sea, is indicated by Table 2. Compared with the corresponding table for 1951, this shows increases in the number of hydrographic stations occupied in 1952, in the amount of chemical sampling and in the experimental introduction of plastic drift-envelopes. Much of the increase is accounted for by concentrated local surveys for particular problems in the Faroe, north-western North Sea and Fladen regions.

Recalling the evidence of the last quarter of 1951 for an increasing accession during that period to the strength of the Atlantic Current in the Faroe-Shetland Channel, to a high climax in December 1951, the hydrodynamical evidence for 1952 points to the slow waning of this influence during the first quarter of the year, but with still a high intensity value of the order of nearly $16 \text{ km}^3/\text{hr}$. in mid-March. By mid-May, however, the decline was substantial, to something of the order of only $4 \text{ km}^3/\text{hr}$.

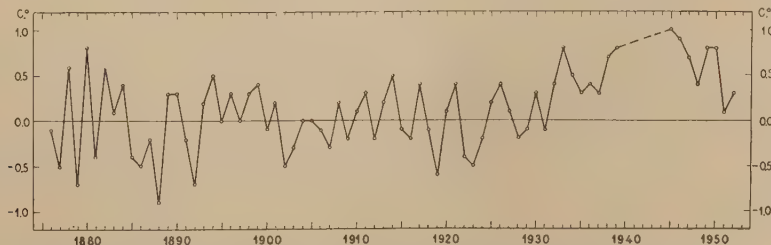


Figure 2. Yearly anomalies of surface temperature in area F (see Figure 1) in the period 1876-1952.

Table 1. Monthly Anomalies ($\Delta^{\circ}\text{C.}$) and Numbers (n) of Observations of the Surface Temperature in the Area F (see Figure 1) during the Years 1876-1952.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average of the Δ -values
	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	Δ n	
1876	—	—	0.4 9	-0.1 17	-0.1 31	-0.7 16	-0.2 7	-0.7 9	0.0 13	0.2 21	0.6 3	—	-0.1
1877	—	—	-0.2 10	-0.7 21	-0.8 22	0.2 4	-1.0 14	-0.5 7	-0.4 15	-0.8 3	0.1 3	—	-0.5
1878	—	—	-0.4 16	-0.2 14	0.9 8	1.3 12	0.8 10	1.5 6	0.8 10	0.4 8	—	—	0.6
1879	—	—	-1.4 6	-1.0 6	-1.3 19	-0.8 18	-1.1 11	-0.2 6	0.2 7	-0.4 1	-0.3 3	—	-0.7
1880	0.4 2	—	0.5 8	0.8 9	0.9 19	0.2 14	1.2 18	1.1 10	1.3 22	—	0.4 2	—	0.8
1881	—	-0.4 2	-0.8 2	-0.7 17	-0.6 8	0.3 15	-0.2 10	-1.1 5	-0.4 14	-1.3 3	0.8 4	—	-0.4
1882	—	—	0.7 22	0.5 25	0.1 17	0.9 24	1.1 15	0.5 10	0.6 24	1.2 9	0.9 7	1.0 6	0.6
1883	0.3 5	0.4 7	0.1 5	-0.2 28	-0.4 32	-0.4 29	1.0 16	0.3 21	0.0 33	0.0 27	-0.1 12	0.1 12	0.1
1884	0.2 11	0.5 13	1.3 25	0.1 36	0.4 35	-0.2 55	0.4 29	0.6 36	0.7 29	-0.1 40	0.4 14	0.2 16	0.4
1885	-0.4 12	0.0 9	-0.1 25	-0.3 38	0.4 46	0.0 23	-0.3 26	-0.4 21	-0.3 30	-1.1 33	-1.2 15	-0.5 10	-0.4
1886	—	-0.8 3	-0.9 11	-0.2 32	-0.6 42	1.0 27	-1.0 26	-1.1 20	-0.6 19	0.3 41	0.3 23	-0.1 12	-0.5
1887	0.2 9	0.1 14	0.8 28	0.1 48	0.1 42	0.4 46	0.3 34	-0.9 13	-0.7 28	-0.1 25	-0.7 16	-1.0 8	-0.2
1888	-0.3 8	-0.4 9	-1.2 15	-1.3 21	-0.8 37	-1.2 24	-1.6 29	-1.1 27	-0.7 30	-1.1 15	-0.8 14	0.2 7	-0.9
1889	0.2 8	-0.8 9	0.4 12	-0.4 13	0.4 24	1.4 30	0.3 17	0.6 16	0.1 20	0.0 13	0.6 2	0.9 2	0.3
1890	1.2 6	0.3 5	0.5 18	0.3 36	0.7 21	0.3 37	-0.6 16	0.1 35	0.3 30	0.2 17	-0.1 15	0.7 8	0.3
1891	-0.1 7	0.3 4	-0.5 18	-0.3 32	-0.4 47	-0.3 44	0.0 25	-0.7 35	-0.4 36	0.0 19	0.4 26	0.2 12	-0.2
1892	0.4 7	-0.8 6	-0.1 16	-0.3 32	-0.7 32	-0.8 39	-1.0 28	-0.6 32	-1.0 32	-0.5 21	-0.5 21	-1.1 17	-0.7
1893	-1.4 2	0.3 3	-0.4 14	0.2 41	1.1 45	1.2 45	0.7 35	0.7 29	0.0 39	0.2 29	-0.6 16	-0.1 21	0.2
1894	-0.9 7	-0.3 12	0.8 24	0.8 29	0.3 41	1.0 45	1.6 22	1.2 19	0.2 23	-0.3 17	0.8 14	0.4 13	0.5
1895	-0.3 10	-1.6 9	-0.5 19	-0.1 31	0.0 54	0.8 46	0.0 31	1.1 29	0.5 39	0.0 17	-0.1 20	-0.2 10	0.0
1896	0.4 11	0.6 17	0.5 25	0.7 48	1.4 46	0.7 51	0.8 39	0.0 33	-0.3 41	-0.6 22	-0.6 16	0.2 14	0.3
1897	-0.3 12	-0.6 16	-0.6 23	-0.3 45	-0.5 44	-0.5 32	-0.1 36	0.9 37	-0.1 40	0.1 23	1.0 19	0.6 12	0.0
1898	0.2 2	1.1 6	0.3 19	0.1 38	0.2 47	0.1 41	-0.7 48	0.0 49	0.2 41	0.7 26	0.7 20	0.5 17	0.3
1899	0.3 13	0.4 6	0.4 21	-0.1 53	0.0 51	-0.5 48	-1.1 60	-0.6 49	0.4 33	0.4 33	0.3 39	0.2 19	0.4
1900	0.2 3	-0.3 4	-0.5 24	-0.4 31	-0.7 38	0.0 37	0.0 42	0.1 38	0.2 43	-0.2 28	0.2 39	0.4 20	-0.1
1901	0.8 20	-0.3 18	0.1 47	0.1 50	0.2 64	-0.2 60	0.7 53	0.5 50	0.5 53	0.5 43	0.3 41	-0.2 19	0.2
1902	0.3 23	0.1 10	-0.4 50	0.1 49	-0.7 56	-1.0 55	-1.3 51	-1.1 56	-0.9 63	-0.3 35	0.0 35	-0.1 30	-0.5
1903	0.0 13	0.2 15	0.3 47	-0.1 53	0.0 51	-0.5 48	-1.1 60	-0.6 49	-0.4 54	-0.2 33	-0.2 35	-0.6 26	-0.3
1904	0.4 13	-0.5 33	-0.3 40	-0.1 54	0.1 65	-0.1 46	-0.2 70	0.2 46	0.1 48	0.4 35	0.3 43	0.1 34	0.0
1905	0.1 23	0.1 26	0.2 40	-0.3 46	0.0 61	0.0 39	0.7 48	0.2 38	0.0 57	-0.7 21	-0.5 43	-0.2 34	0.0
1906	0.2 20	-0.3 35	-0.4 72	-0.3 58	-0.7 64	-0.6 66	-1.0 65	-0.4 46	0.2 64	1.0 41	0.4 39	0.6 21	-0.1
1907	-0.1 14	0.0 35	0.0 46	-0.2 64	-0.2 73	-0.9 75	-0.8 71	-1.2 54	-0.9 75	0.0 51	0.0 57	0.4 23	-0.3
1908	-0.1 13	0.0 33	0.0 33	-0.1 56	0.0 61	-0.1 58	0.1 57	-0.1 52	0.0 54	0.9 42	0.6 47	1.4 18	0.2
1909	-0.1 13	0.6 28	-0.1 36	0.0 56	-0.3 50	-0.5 42	-0.4 50	0.0 45	-0.4 49	-0.3 40	-0.7 28	-0.5 17	-0.2
1910	-0.2 10	-0.3 19	0.1 34	0.0 44	0.1 64	0.8 48	0.0 61	0.8 46	0.3 53	0.7 41	-0.6 44	-0.3 24	0.1

1911	-0.7 15	0.0 31	0.0 52	0.2 48	0.8 60	1.0 56	0.6 34	1.3 47	0.3 50	-1.0 64	-0.8 46	-0.4 60	-0.8 32	-0.2
1912	-0.2 28	0.1 32	0.5 37	0.6 36	0.7 63	0.8 60	-0.3 95	1.4 50	0.1 55	-1.0 64	-0.8 46	-0.4 60	-0.8 32	-0.2
1913	-0.7 23	-0.1 41	0.1 49	-0.2 44	0.3 84	0.2 75	0.2 107	0.2 69	0.4 51	0.8 44	0.7 61	0.7 61	0.7 26	0.2
1914	0.4 13	0.7 28	0.6 29	1.1 36	0.4 46	0.5 52	0.6 90	0.6 54	-0.2 23	0.6 41	0.9 15	0.9 15	-0.3 20	0.5
1915	0.4 13	0.0 36	0.3 34	-0.1 34	0.2 31	0.6 69	-0.4 45	0.3 57	0.3 26	-0.2 48	-1.4 12	-1.4 12	-0.7 21	-0.1
1916	-0.4 11	0.6 12	-0.6 26	-0.2 19	0.0 31	-0.7 33	-0.1 54	0.0 44	-0.5 44	-0.6 40	-0.2 31	-0.2 31	0.1 28	-0.2
1917	-0.6 24	—	—	—	—	—	1.4 6	—	—	—	—	—	—	0.4
1918	—	—	—	—	—	—	—	—	—	—	—	—	-0.1 4	-0.1
1919	—	-0.2 4	-0.4 16	-0.1 15	0.4 17	-0.3 24	-0.4 23	-0.3 25	-1.0 23	-1.9 42	-1.9 42	-1.9 42	-0.8 17	-0.6
1920	-1.3 33	0.0 14	0.3 16	-0.1 15	-0.1 14	0.9 23	-0.1 54	-0.1 32	-0.5 45	0.7 58	0.3 32	0.3 32	0.7 24	0.1
1921	-0.4 15	0.8 18	1.0 35	1.1 21	0.9 34	-0.1 42	0.0 50	-0.4 57	0.1 46	0.7 46	-0.6 55	-0.6 55	0.9 11	0.4
1922	-0.2 20	-0.4 13	-0.4 23	-0.5 59	-0.3 30	-0.4 25	-1.0 68	-0.6 41	-0.5 63	-0.3 48	-0.3 48	-0.3 48	0.0 10	-0.4
1923	0.3 25	0.1 25	0.1 34	-0.1 32	-0.7 57	-1.6 41	-0.7 54	-0.8 48	-1.0 56	-0.7 36	-0.7 36	-0.7 36	0.2 13	-0.5
1924	-0.7 21	-0.4 10	-0.9 13	-1.0 38	-0.3 50	-0.9 37	0.1 51	0.2 38	-0.1 56	0.1 34	0.2 38	0.2 38	1.6 17	-0.2
1925	0.5 21	0.5 36	0.2 50	0.3 66	0.4 71	0.2 97	0.7 69	0.8 67	-0.9 52	-0.4 58	-0.3 42	-0.3 42	-0.2 31	0.2
1926	0.0 30	0.0 30	0.2 40	0.8 52	0.7 46	0.6 78	1.2 67	1.0 30	0.7 62	-0.2 48	-0.2 48	-0.2 48	0.3 44	0.4
1927	0.2 45	0.7 34	1.3 32	0.5 31	-0.5 44	-0.8 21	0.4 33	1.2 32	-0.1 32	-0.3 49	-0.8 58	-0.8 58	-0.7 38	0.1
1928	-0.2 21	0.1 45	0.0 45	-0.1 50	-0.1 58	-0.7 47	-0.8 44	-0.6 59	0.1 42	0.0 52	0.3 59	0.3 59	0.2 50	-0.2
1929	-0.3 29	-0.5 48	0.5 47	0.0 51	0.0 44	-0.1 39	-0.5 62	-0.3 61	0.3 62	-0.2 48	-0.2 51	-0.2 51	0.1 30	-0.1
1930	0.2 43	0.0 37	0.0 64	0.2 53	0.1 60	0.8 53	0.5 82	0.6 64	0.4 75	-0.2 60	-0.4 37	-0.4 37	0.5 18	0.3
1931	0.3 40	0.1 38	-0.8 43	-0.5 41	-0.4 50	-0.3 62	-0.5 50	-0.3 58	-0.4 60	0.1 43	0.5 22	0.5 22	1.2 14	-0.1
1932	0.9 33	1.1 20	0.8 43	0.3 34	0.1 45	0.3 49	0.7 42	0.5 45	0.1 46	-0.1 46	0.0 54	0.0 54	0.4 26	0.4
1933	0.4 30	0.3 25	-0.2 30	0.2 58	0.8 59	1.4 55	1.7 56	1.0 38	1.5 61	0.9 43	0.5 39	0.5 39	0.6 31	0.8
1934	0.3 30	1.3 49	0.4 56	0.3 45	0.1 68	0.0 56	1.0 42	0.6 42	0.6 57	0.4 61	0.0 34	0.0 34	0.9 18	0.5
1935	0.9 30	0.7 42	0.2 49	0.4 58	0.4 56	-0.5 35	-0.1 48	0.7 55	0.7 44	0.2 49	0.2 39	0.2 39	0.2 42	0.3
1936	-0.1 25	-0.2 35	0.1 50	0.1 37	0.3 64	1.1 37	1.2 44	0.8 49	0.9 48	0.1 30	0.5 27	0.5 27	0.2 18	0.4
1937	0.5 23	0.1 18	-0.6 30	-0.3 52	0.3 52	0.1 48	0.2 60	0.9 40	0.0 51	1.0 27	0.7 49	0.7 49	0.4 25	0.3
1938	0.3 31	0.7 33	1.3 36	0.8 43	0.6 44	0.3 53	0.3 43	1.1 45	0.8 36	0.6 32	0.7 32	0.7 32	1.0 27	0.7
1939	0.2 27	0.6 31	0.9 32	0.3 45	0.8 34	0.7 39	-0.1 37	1.4 37	2.3 3	—	0.8 4	0.8 4	0.8 7	0.8
1945	—	—	—	—	—	—	—	—	—	1.7 4	—	—	0.4 8	1.0
1946	1.3 3	1.2 7	1.5 14	—	0.7 14	0.7 8	0.3 23	0.8 21	0.6 22	0.8 47	1.1 13	1.1 13	0.8 28	0.9
1947	0.5 27	-0.5 21	-0.7 14	-0.5 24	0.1 21	-0.2 23	2.1 32	2.8 19	1.6 27	1.0 32	0.7 30	0.7 30	1.0 11	0.7
1948	0.2 25	0.6 20	0.8 31	1.2 28	1.0 31	0.3 44	-0.5 41	0.1 20	-0.2 21	0.0 47	0.0 27	0.0 27	1.3 24	0.4
1949	1.2 23	2.2 12	0.3 16	1.0 10	0.4 26	0.4 18	0.9 25	0.1 25	1.0 47	1.0 39	1.0 31	1.0 31	0.7 39	0.8
1950	1.3 15	0.8 19	1.1 35	0.6 39	0.6 54	1.2 56	0.8 55	1.5 41	0.7 45	0.7 45	0.0 21	0.0 21	-0.2 16	0.8
1951	-0.3 14	0.1 19	-0.3 37	-0.5 43	-1.0 38	0.1 49	-0.4 37	0.0 49	0.4 42	1.1 30	1.0 45	1.0 45	0.7 29	0.1
1952	0.4 37	0.4 34	0.7 40	1.0 55	1.3 75	0.0 54	0.2 48	0.5 66	-0.6 44	-0.3 66	-0.1 45	-0.1 45	-0.1 31	0.3

Table 2. Scottish Hydrographic Operations 1952.

Vessel	No. of Hydro-graphic Stations	No. of Temper. Observations	No. of Salinity Observations	No. of Oxygen Observations	No. of Phosphate Observations		No. of pH Observations	Drift-Bottles			Drift-Envelopes	
					Free Phosphate	Total Phosphate		No. Libtd.	No. Recd.	R% L	No. Libtd.	No. Recd.
"Scotia".....	672	4787	4235	1124	1516	453	30	710	—	—	200	5
"Explorer".....	410	2904	2678	452	568	389	—	710	—	—	—	—
"Clupea".....	640	2480	2107	81	1182	430	—	—	—	—	—	—
"Kathleen".....	68	214	188	—	—	—	—	—	—	—	—	—
"Silver Scout".....	151	480	342	—	137	—	—	—	—	—	—	—
"North Carr" Light-ship.....	79	79	79	—	—	—	—	—	—	—	—	—
Weather Ships.....	—	—	—	—	—	—	—	1221	—	—	—	—
Total.....	2020	10944	9629	1657	3403	1272	30	2641	—	—	200	5

The nadir in the intensity of the current appears to have been of comparatively short duration, for by the end of June the volume transport of oceanic water through the Faroe-Shetland Channel was estimated at between 8 and 10 km.³/hr. A similar value was derived for the second week in November, indicating again at least fairly strong oceanic activity in the Channel towards the end of 1952, the fourth successive year in which this phenomenon has been apparent.

Turning to the drift-bottle records for the year under review, Table 3 sums the results to date in the form previously defined¹). Compared with 1951 there is at once apparent a notable (almost 100 %) increase in the proportion of recoveries recorded from the 1952 liberations. This increase is particularly noticeable in respect of returns from the Skagerak region (Column 11) and from the Norwegian coast beyond the North Sea (Column 13). The apparent decline in Irish coast recoveries (Column 0) was due to there being no research cruise west of Ireland in 1952. Weather Ships' drift-bottle returns for 1952 (Tables 4 and 5) show that Irish coast recoveries were fully represented in, again, a proportionately greater

return from 1952 liberations than from those of 1951. One of these, liberated in September 1952, made the remarkable passage from longitude 19° W. on latitude 59° N. to the north coast of Ireland when it was recovered in February 1953.

It is also to be observed that at least two drifters from the more southerly Weather Station (J) passed into the North Sea to strand in August and September respectively on the North Sea Norwegian coast and within the Skagerak, while from the northerly station (I) a further two bottles reached Moray Firth shores, also in August.

Similar records are included among the returns from Faroe-Shetland Channel liberations of 1952 as is evident from Table 6. An analysis of all eastern North Sea recoveries from the year's liberations reveals the following interesting features.

1. All seven recoveries on the west Danish coast south of Hanstholm (Column 10) took place from the middle of June to September.

2. Skagerak recoveries also took place mainly from June to September but with a preponderance in July, then a few recoveries in October and November, 1952, and two more in March 1953.

¹) See Ann. Biol. 8, 1951, p. 94.

Table 3. Scottish Surface Drift-Bottle Liberations 1952.

Liberations (L)		Recoveries (R)																			Total	R% L
Year	No. of Drifters	0 ¹	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
1952	1410	—	4	20	33	20	2	6	2	—	—	—	7	61	29	93	10	1	1	—	289	20.5

Table 4. Weather Station J.

Liberations (L)				Recoveries (R)																	Total	$\frac{R}{L}\%$
Year	No. of Drifters	Frequency-Distribution																				
		0 ¹	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
1952	655	—	31	9	6	—	—	—	—	—	—	—	—	1	1	3	—	—	—	—	51	7.8

Table 5. Weather Station I.

Liberations (L)		Recoveries (R)																			Total	$\frac{R}{L}$ %
Year	No. of Drifters	Frequency-Distribution																				
		0 ¹	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
1952	576	—	4	30	23	2	2	—	—	—	—	—	—	—	—	5	—	—	—	—	66	11.5

3. North Sea Norwegian coast returns were fairly evenly distributed over the period June to September, and revived again in December, reaching a maximum in January 1953 and again falling off in February.

4. Norwegian coast recoveries outwith the North Sea were maximal in July and August, falling off gradually from September to November and increasing once more from December 1952 to March 1953.

These circumstances link up with the later results of 1951 and with the Faroe-Shetland hydrodynamical survey of the last quarter of that year, together with the foregoing hydrodynamical essays during 1952, in the following interpretation.

The abnormally powerful Atlantic Current in the Faroe-Shetland Channel at the end of 1951 gradually waned in strength during the first quarter of 1952 and more rapidly thereafter to a minimum in the month of May. It revived again during the summer to a new maximum, probably in the month of August, slightly waned during the next two to three months, but began again to increase in intensity in the last month of the year.

J. B. TAIT

Chemical Observations.

The detailed study of the distribution of nutrients, in particular free phosphate and dissolved oxygen, was begun in Aberdeen at the end of 1949. Since then a large number of data, diffusely covering an area extending

from Iceland to the Danish coast and from Rockall to Norway, has been assembled. The results are well scattered in time and in area distribution. In the following account and diagrams, some of the best-established features are presented, principally as they are illustrated by the 1952 results.

The winter free-phosphate surface diagram (Fig. 3) is based on 169 observations covering 61 squares, and that for oxygen (Fig. 4) on 109 values in 57 squares, both supplemented by many more data from previous years and for the winter of 1953. It is emphasised that these diagrams are not strictly mathematical presentations, such as can be used to interpolate phosphate and oxygen values accurately for a given position, but are generalised representations, particularly typical of 1952, of the values found over the area as a whole.

The winter values for free phosphate are broadly repeated from year to year, during the period from late January until early April, (though the values are not exactly invariable). These quantities represent about 80—90 % of the "total phosphate" present in the water as determined by HARVEY's method¹).

When compiling Figure 3, values were restricted to those which relate to conditions of (a) no temperature stratification (b) uniform salinity and (c) uniform phosphate and oxygen concentrations, all between surface and bottom (or, in deeper waters, between surface and 100 metres). Very occasionally, low sur-

¹) HARVEY, H. W.: Journ. Mar. Biol. Ass. 1948, **27**, p. 337.

Table 6. Faroe-Shetland Channel Liberations 1952.

Liberations (L)		Recoveries (R)																	R L %
Year	No. of Drifters	Frequency-Distribution																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total	
1952	490	—	24	6	—	—	—	—	—	—	1	6	3	33	6	—	1	80	16.3

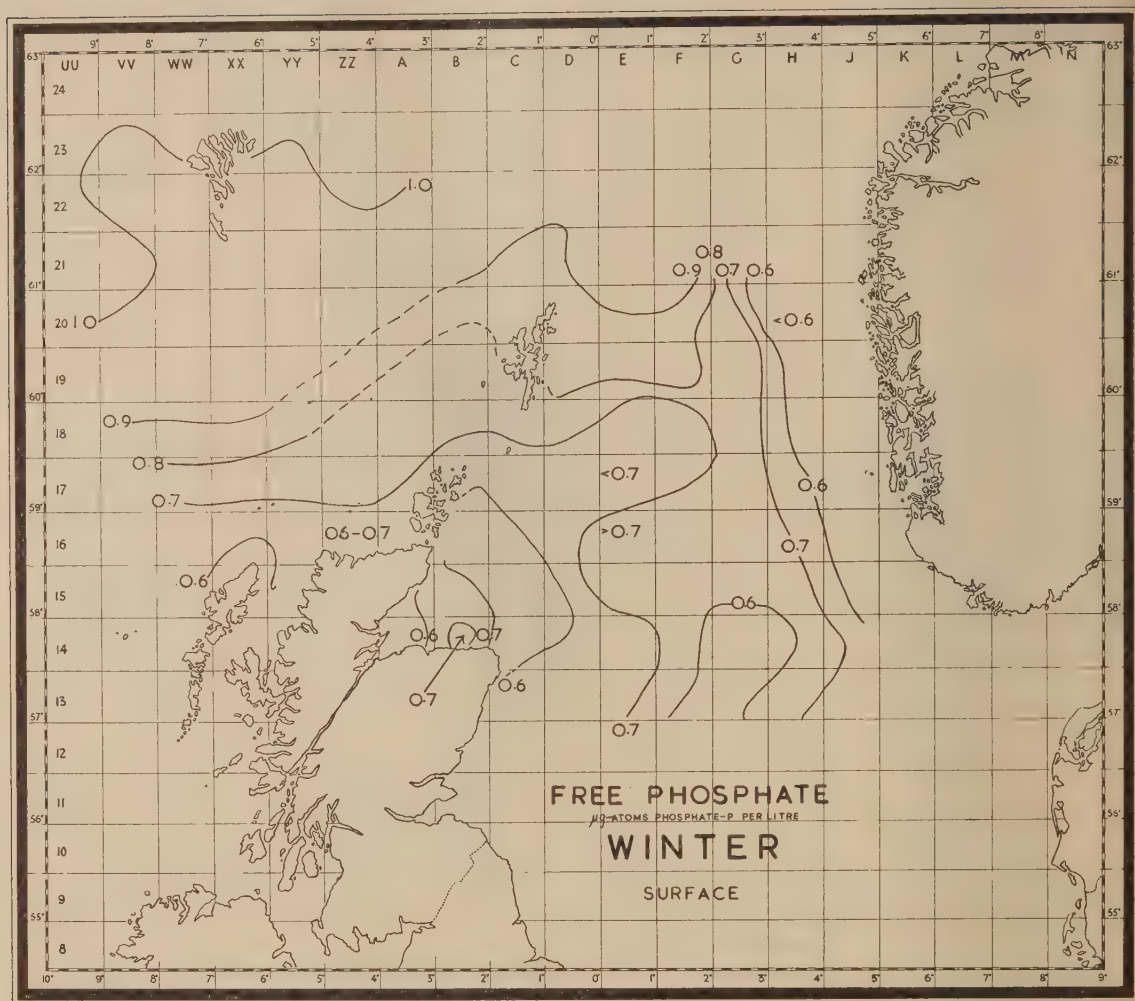


Figure 3.

face phosphate values were encountered in early April; these low values were discarded in favour of observations at a lower depth. The diagram is most close to conditions during February and March.

It is more difficult to obtain a simple picture of the winter dissolved oxygen distribution, since values for any one year are frequently insufficient for a reliable diagram and also values are found to vary to a relatively greater extent than the phosphate from year to year and within a limited area. The diagram (Fig. 4) shows the most commonly observed features, with typical values based on observations from the years 1950, 1951, 1952 and 1953.

In conjunction with these diagrams, readers are referred to the Notes and Diagrams of the *Synoptic Hydrographic Charts* for February and March 1952, circulated by J. R. LUMBY (Fisheries Laboratory, Lowestoft). These diagrams show the main surface features (temperature and salinity) of the principal water masses at Faroe, in the Faroe-Shetland Channel, Scottish coastal waters, northern North Sea and offshore Norwegian coastal water.

The highest winter free-phosphate concentrations occur in the Faroe region. Values are also high in the north-east Atlantic Ocean and presumably extend into the Norwegian Sea. Inshore phosphate values are not much greater

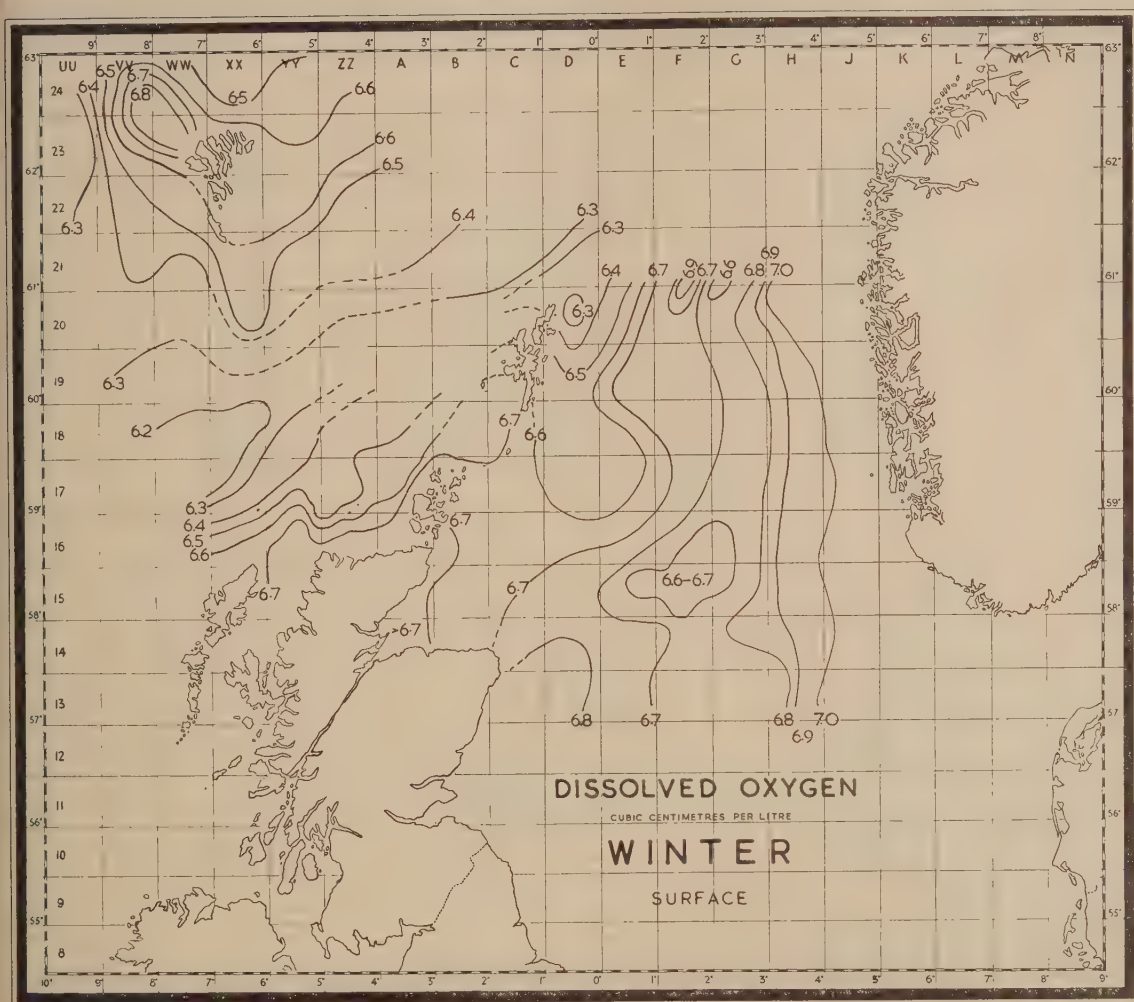


Figure 4.

than half those offshore in these areas, and are least in the north Minch and in the low salinity surface water off the Norwegian coast. In general the phosphate value decreases sharply with decrease in salinity below approximately 34 ‰. North Sea values are all in the vicinity of 0.7 μg -atoms phosphate-phosphorus per litre, and exceed 0.8 only in the region of the main oceanic influence, where salinity values are above 35.3 ‰.

Oxygen distribution, when analysed with due regard to the different unit employed, is also linked with the main water masses and the surface current system. Water in the Faroe-Shetland Channel associated with high salinity

has a dissolved oxygen content of up to 6.3 or 6.4 cc. oxygen per litre. This value increases to about 6.6 for the extension of this water mass into the northern North Sea, in association with a drop in temperature of 1–2°C. The variable oxygen values along latitude 61°N. in the North Sea (associated with similarly variable salinity and temperature distribution) point to some complexity between oceanic inflow and North Sea outflow between 1°30' and 3°00'E. At Faroe, inshore oxygen concentrations are high, as in all coastal waters, and the regional influence of the relatively low oxygen of the North Atlantic water is clearly shown. Its effect is least to the north-

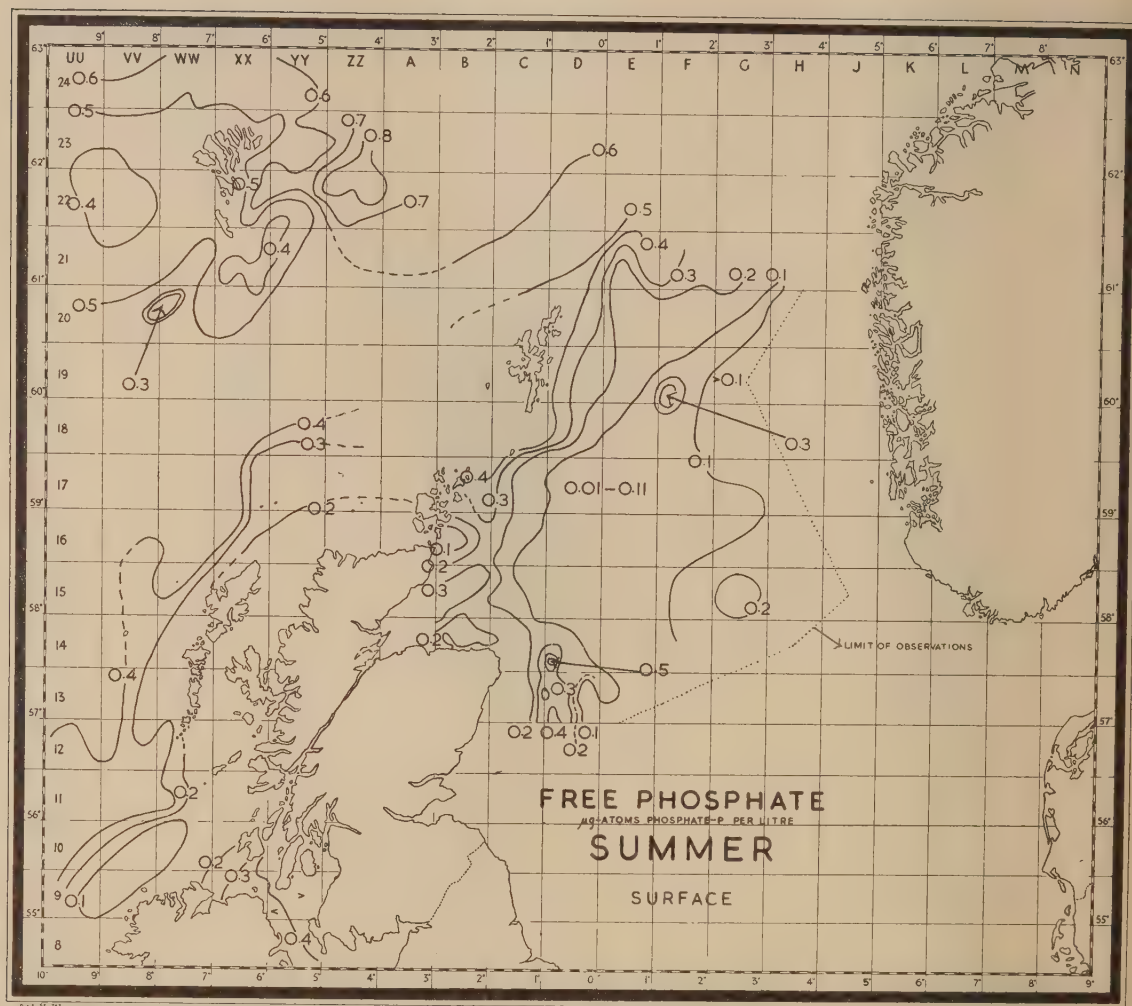


Figure 5.

east of the Islands, (see LUMBY's Temperature Diagram for March 1952). In all areas, values greater than *ca.* 6.75 are associated with temperatures of less than 6°C.

Similar pictures of free phosphate and oxygen distributions have been compiled for July (Figs. 5 and 6). Again the intention has been to give preference to those 1952 figures which are supplemented and confirmed by observations from the other years. It is evident that very large changes have taken place since the winter in both the phosphate and the oxygen concentrations. A notable depletion of free phosphate occurred in the central part of the northern North Sea and perhaps also in the eastern part, though data are not very

abundant for the latter region. At Faroe a considerable proportion of the phosphate had been used and certain British coastal waters had become almost completely devoid of phosphate by July. Associated with these important phosphate changes there are two distinct types of change in the dissolved oxygen concentration. In the central area of the northern North Sea, and between the north Irish coast and the south Minch, the oxygen concentration had fallen markedly while, directly in contrast, values in the Faroe region had mostly increased. A less sharp distinction is evident in other coastal regions where values vary locally in a complex manner; some showing marked diminution, others little or none.

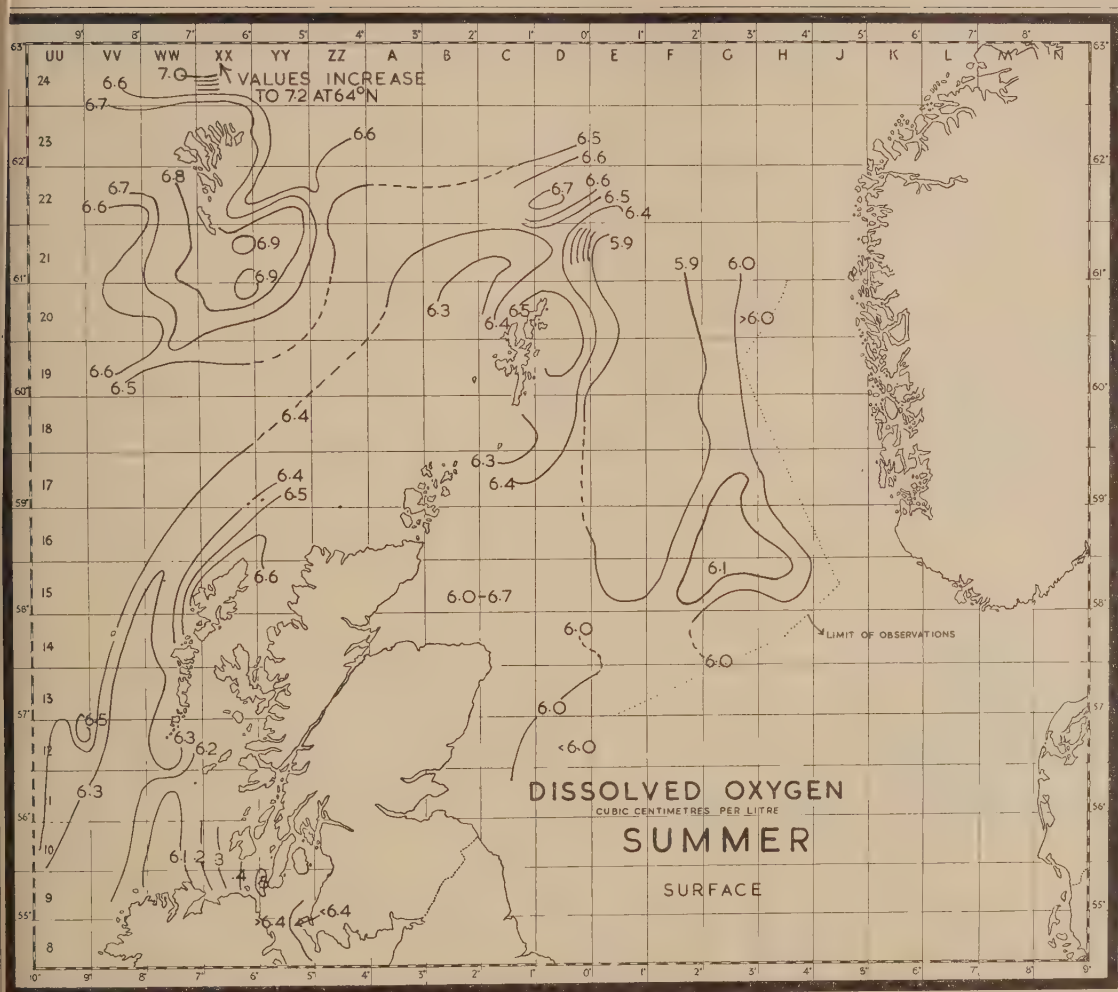


Figure 6.

Areas in which the oxygen content is high and the phosphate reduced accord with the areas of active phytoplankton growth at or just prior to this period. It is believed that where the oxygen content is low, the main spring plankton growth had been over for some time, the phosphate being maintained at a low level by the zooplankton and by flagellates which feed on the remains of the previous plankton production, and by loss of phosphate to the bottom layer due to the sinking of dead plankton. Mid-Faroe/Shetland Channel plankton had by July passed the peak and oxygen values had fallen from the May-June values (ca. 6.8); they were due to continue their fall to about 5.9 in the late autumn, before increasing to the original values

during the winter months. In the central region of the northern North Sea phosphate concentrations recovered a little during August and September, before becoming rapidly depleted during October when the autumn phytoplankton growth occurred. Later, when the warm surface layer cooled and winter mixing commenced, uniform phosphate values of some 0.4—0.5 $\mu\text{g. at. PO}_4/\text{P}$ were produced, while the oxygen content reached the minimum value for the year of some 5.6—5.7 cc. $\text{O}_2/\text{l.}$

The detailed data on which these generalisations are based are being published in the Council's *Bulletins Hydrographiques* and a more detailed assessment of them will appear elsewhere.

R. JOHNSTON

Table 7. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessel "Vyl" for a longer Series of Years, and Anomalies from these Means.

(From the Danish Meteorological Institute, Nautical Department).												
Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity												
Surface												
Mean.....	32.6	32.4	32.2	32.4	32.3	32.6	32.5	32.4	32.6	32.4	32.4	32.3
1952.....	0.6	0.3	0.1	0.0	0.2	0.1	0.0	-0.1	0.0	-0.1	0.4	0.0
Bottom												
Mean.....	33.0	32.8	32.7	32.8	32.6	33.1	32.9	32.7	32.8	32.6	32.7	33.0
1952.....	0.7	0.4	0.2	0.3	0.7	0.1	-0.2	-0.1	0.1	0.0	0.6	0.2
Temperature												
Surface												
Mean.....	3.2	2.2	2.6	4.8	8.8	12.4	15.2	16.1	15.0	12.2	8.5	5.4
1952.....	2.0	1.4	0.4	-0.1	0.8	-0.7	-0.2	0.2	-0.3	-0.7	-0.2	0.2
Bottom												
Mean.....	3.9	2.6	3.0	4.7	7.9	11.1	14.1	16.0	15.2	12.7	9.0	6.2
1952.....	2.3	1.5	0.6	-0.1	-0.9	0.3	-0.3	0.2	-0.1	-0.8	0.2	-0.3

HELGE THOMSEN

Hydrographic Conditions in the Southern North Sea, the "Bløden" Ground Area in 1952.

In the area in question the R/V "Dana" has in 1952 made three sections, viz. the international R-section (R3—R14) from 26. to 28.

April, the international S-section (S2—S15) from 28. to 29. April and finally a section beginning at Da 8373 (53°30'N.—3°00'E.) ending at Da 8383 (56°30'N.—7°00'E.) worked from 24. to 25. August. See Figures 7—10.

The Danish observations in April-May of recent years (1947—1951) seem to show that low bottom temperatures are found on the "Bløden" ground. A single exception from this is an R-section from April 1949. On the sections from 1952 these conditions are found again. The cold water may be stationary, as it is found again even more pronounced on the August section. It can be seen that the bottom temperature has only risen about 3°, whereas the surface temperature has risen about 10°.

Another remarkable thing, as is seen from the R-section, is that though the cold water is found all over the "Bløden" ground, such low temperatures are not found on the north side of the Doggerbank even in very low strata. A similar feature can be found on the S-section, but here the conditions are more indistinct, and the differences less. This trait is found most often on the sections from the preceding years, the R-section from May 1948 forming an exception, however.

K. P. ANDERSEN



Fig. 7. Distribution of bottom temperature and salinity. April—May 1952.

..... R and S-sections. ▲.....▲ August section.

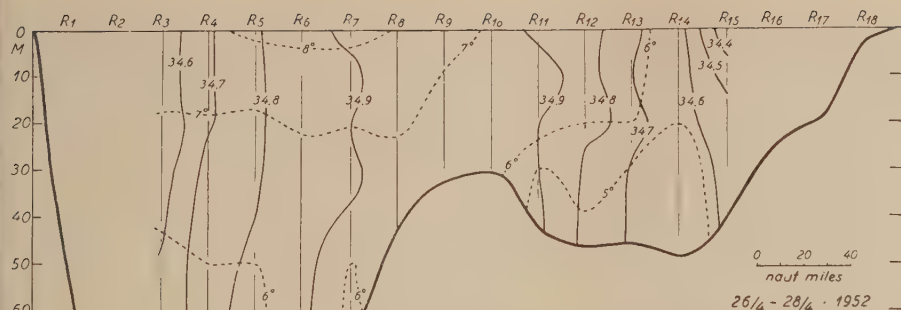


Figure 8. Distribution of temperature and salinity. R-section. April 1952.

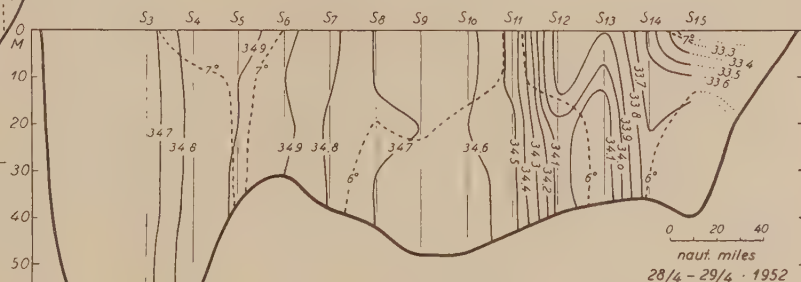
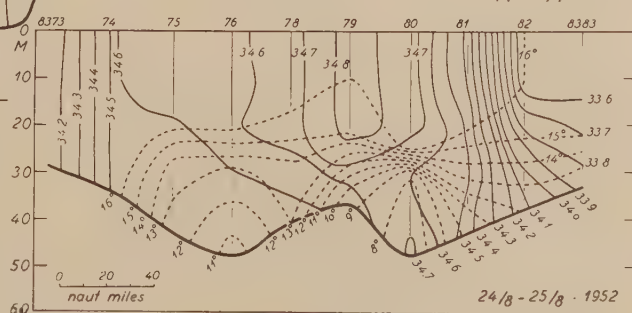


Figure 9. Distribution of temperature and salinity. S-section. April 1952.

Figure 10. Distribution of temperature and salinity. August section 1952.



Southern Bight. - Synoptic View.

The object of the "Gauss" cruise to the south-western North Sea commencing on 26. February and ending on 19. March 1952, was to investigate the relations between the distribution, extension and mixing of the water masses on the one hand, and between the water masses, plankton content and distribution of the pelagic fish fry at the spawning time of plaice on the other hand. Ten self-recording paddle-wheel current-meters were laid out in the area during the period of observation. A dense grid of oceanographical and biological stations run at the beginning of the cruise and repeated at the end yielded a quasi-synoptical picture of the hydrographic and biological conditions on two different days. The results of these investigations by G. DIETRICH¹⁾, J. JOSEPH²⁾ and K. KALLE³⁾ concerning

the hydrographical conditions are being published in conjunction with the results of fish fry investigations made by A. BÜCKMANN and plankton investigations by J. KREY. The present paper wishes to convey some hydrographic results only.

The Southern Bight of the North Sea is known as a mixing area for four water masses differing in their physical and chemical proper-

¹⁾ G. DIETRICH: Verteilung, Ausbreitung und Vermischung der Wasserkörper in der südwestlichen Nordsee auf Grund der Ergebnisse der "Gauss"-Fahrt im Februar-März 1952. — Ber. Deutsch. Wiss. Komm. Meeresforsch., N. F., 13, 1953.

²⁾ J. JOSEPH: Die Trübungsverhältnisse in der südwestlichen Nordsee während der "Gauss"-Fahrt im Februar-März 1952. — Ibid.

³⁾ K. KALLE: Der Einfluss des englischen Küstenwassers auf den Chemismus der Wasserkörper in der südlichen Nordsee. — Ibid.

ties, according to their origin. The water of the Channel proved to be relatively warm, of high salinity and it was characterized by slight turbidity; the same applies to the water from the central North Sea. The British coastal water and the continental coastal water showed relatively low temperatures and salinities and considerable turbidity. In particular, the British coastal water contained biologically active nutrients. From rough computations and measurements of the phosphorus content in the river Thames, K. KALLE concludes that the main sources for these amounts of organic matter in the British coastal water are the waste waters of London and that this manure contributes to the higher fish yields in the south-western North Sea as compared with those in the English Channel and the remaining North Sea. In the characterization of the water masses of various origin the turbidity (extinction) proved particularly suitable, because the constant recording *in situ* with a new apparatus of J. JOSEPH permits a rapid determination of the distribution of the water masses to be made while the ship is underway.

The observations made on the geographical distribution of temperature, salinity and turbidity at the beginning of March and in mid-March suggest that the characteristic water masses have meanwhile moved considerably which leads us to questions relating to their extension and mixing. On the line Texel—Dogger Bank where current measurements were carried out with four paddle-wheel current-meters over 15 days the residual current was found to be directed to the German Bight. Its velocities off Texel temporarily exceeded 60 cm. per second. But not only the high velocities demand our attention, but also the fact that the speeds of the wind decreased in all measuring positions as the velocity of current rose. The causes were the overall wind conditions over the North Sea. The Russian area of high pressure advancing westward produced a strong south-easterly gale, temporarily reaching a force of 10 (Beaufort scale) over the north-eastern North Sea and the Skagerak, while simultaneously the force of the wind over the south-western North Sea decreased. Thus the north-eastern North Sea was emptied owing to the surface currents produced by the wind, and the surface gradient from south to north produced in this manner resulted in a strong outflow of water from the south-western North Sea which was directed

eastward to north-eastward to the German Bight, with the Coriolis forces cooperating.

The average residual current over a period of 15 days totalled 126 miles in a position 10 miles north-west of Texel island, while it amounted to 51 miles in a position 30 miles north-west of Texel and to 83 miles, in a position 50 miles north-west of that island. Thus, while the movement of the characteristic water masses conformed to the directions of current measured as far as the direction was concerned, the moving velocities given in the same succession were only 17, 17 and 40 miles respectively. It is concluded from these observations that, as the water masses approach, horizontal mixing processes increasingly cooperate in the extension of water masses.

The mechanism of this mixing process is the subject of G. DIETRICH's studies of "Gauss's" one-day anchoring station north-westward of Texel, which had been arranged so that the narrow transitional zone from continental coastal water to the water of the English Channel could be observed. The distribution of temperature and salinity from surface to bottom in a depth of 30 m. had been hourly determined. In addition, records of a "Bifilar" type current-meter from 5, 10, 20, and 27 m. and of two paddle-wheel current-meters from 10 and 28 m. were available. In certain phase sections of the tidal streams, the measurements reveal a strong density discontinuity layer which is at the same time connected with a discontinuity in the direction and velocity of the tidal stream. In the upper layer of 0—15 m. the tidal stream turns to the right; in the lower layer, to the left. The measuring results showed that the density of the water remained unstratified when the tidal streams had the same direction throughout the whole column of water. As soon, however, as the directions of current vary in that the currents become offshore in the upper layer and onshore in the lower layer, an upslide occurs, resulting in an appreciable stratification of the density, since water masses varying in density are close to each other in the transitional zone between the two water masses. This stratification essentially reduces the vertical exchange thus making friction smaller and facilitating the upsliding notion. It supports the formation of the offshore component of the surface current as well as of the onshore component at the bottom. After six hours the directions of the tidal stream at the surface and at the bottom are

again adapted to each other. As the velocities increase simultaneously the stratification of the density is entirely undone owing to turbulence.

So far measurements of these striking phenomena are only available from a single day and a single position. There is reason to believe that these processes, though they may not take place continually, find conditions favouring their origin in the area north-westward of Texel and Vlieland, viz., in the vicinity of the coast, residual currents along the coast, strong tidal currents that are not purely alternating and an appreciable horizontal discontinuity layer of density. Therefore G. DIETRICH supposes that these processes off Texel and Vlieland are of considerable durability. It is intended to use future research cruises in the "Gauss" to find further explanation of these processes, because they may play an important part in two respects. (1) If, in a phase section of the tidal stream, continental coastal water of low salinity slides over Channel water of high salinity, and if, in the next phase section, this stratification is dissolved by strong vertical mixtures, these processes finally result in an unusually strong horizontal mixing. If the parallel existence of the characteristic water masses in the south-western North Sea ends north-westward of Texel, the above-mentioned mixing processes will probably play an important part in this. (2) If in one phase of the tidal stream, the offshore movement in the surface layer and the onshore movement in the bottom layer is particularly pronounced, the average residual current components will be directed to the corresponding directions. On the day of measuring the residual current components were, in a depth of 10 m., on an average of 25 hours, 7.2 cm./sec. offshore and in a depth of 28 m. 6.7 cm./sec. onshore. As far as these conditions are permanent the movements will be of importance for the transportation of all suspended matter. Near the bottom they influence the transport of fish fry and also of sand towards the coast of Texel and Vlieland.

G. BÖHNECKE

Hydrographic and Plankton Surveys off the North-East Coast of Scotland.

The major oceanic inflow to the northern North Sea is generally recognised to occur via the north of the Shetland Islands (HELLAND-HANSEN, 1905; TAIT, 1930, 1932, 1934, 1937,

1947; and others). ROBERTSON (1913) and more recently SMED (1947) have stated that there is generally a large inflow between the Orkney and Shetland Islands, while FRASER (1949, 1951, 1952) has deduced a frequent inflow, at least between Fair Isle and Orkney, from the study of plankton indicator species.

During the 1951 series of hydro-biological surveys covering the area of the Fraserburgh and Peterhead herring fisheries, there was evidence of an intrusion in the north-west corner of the survey area. The lower and mid-water layers of this were considerably warmer than in any other part of the area and it contained a richer plankton, especially during early May. Later in the year this intrusion was lost to hydrographic observation by the general rise in surrounding temperatures but the plankton still showed some difference. It was considered by the authors that this water might be derived from the Orkney-Shetland channels.

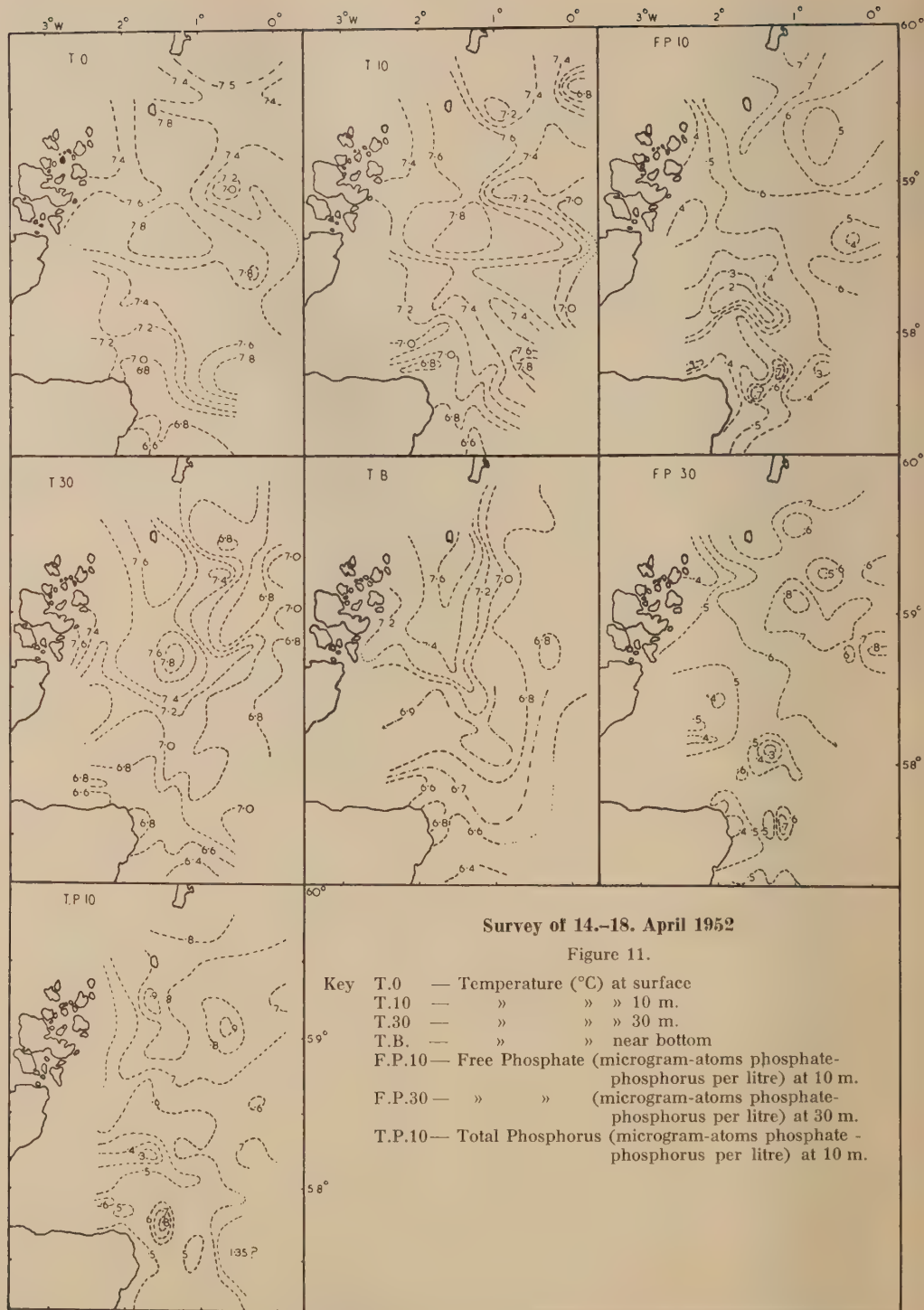
The April Survey.

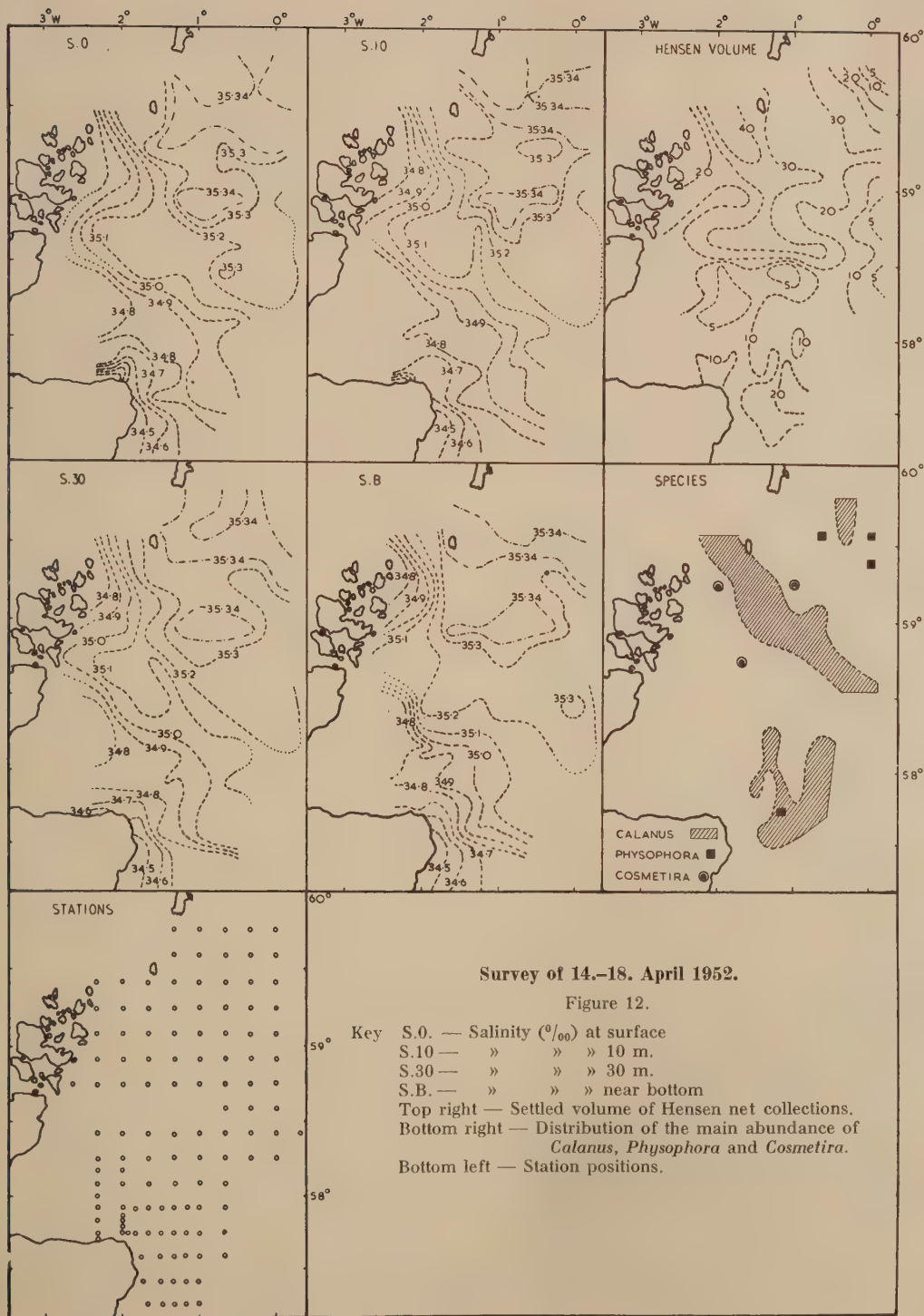
This survey was the first of a series to be worked as opportunity allows. The object of these is to obtain more evidence on the subject by intensive surveys of a relatively small area, in this case some eight thousand square miles. Observations were made at 110 stations as follows: temperature and salinity — surface, 10 m., 30 m., and near bottom; free phosphate — 10 m. and 30 m.; total phosphorus — 10 m. only. A single haul with the Hensen net was made at each station, from near bottom to surface.

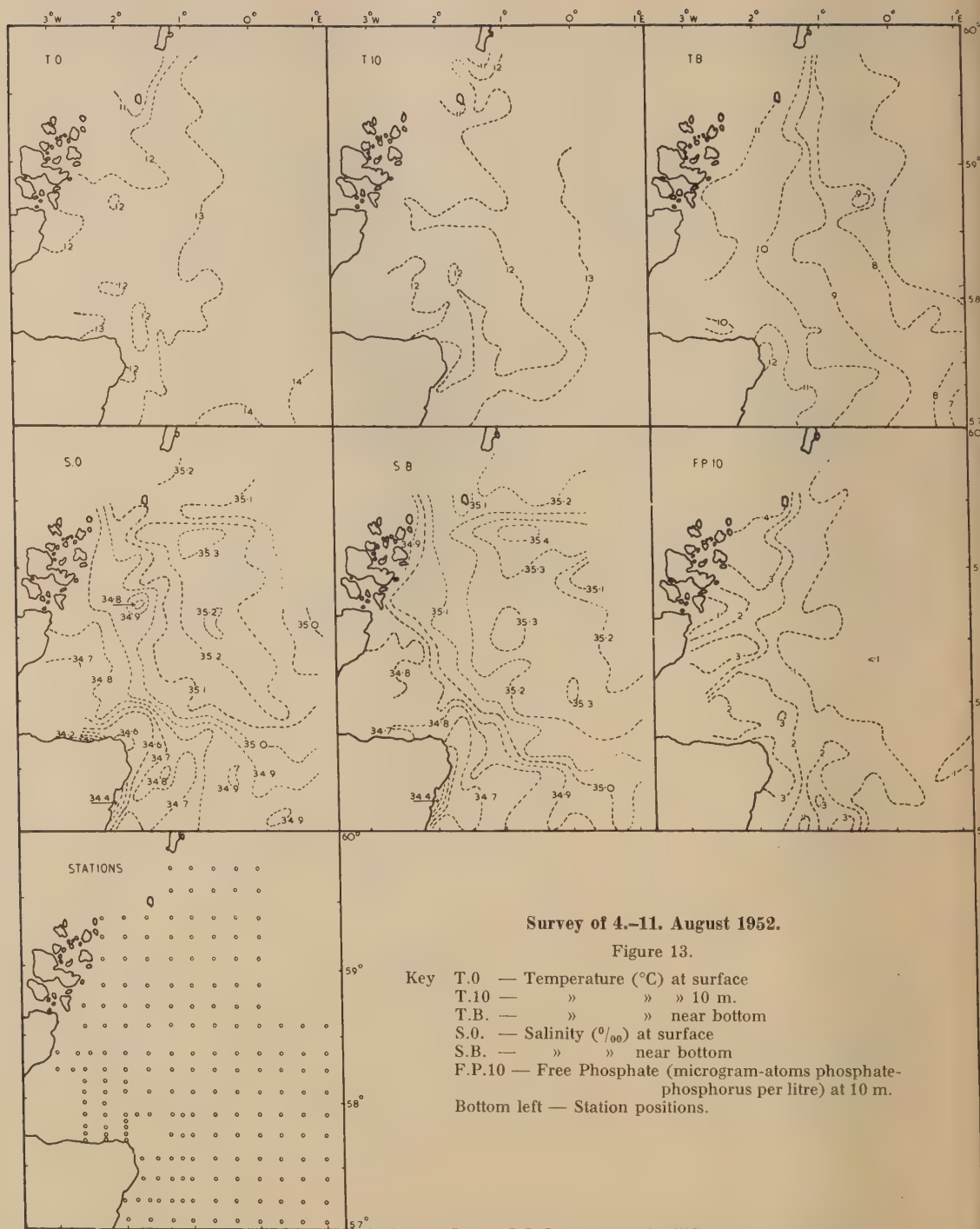
The distribution of hydrographic observations was selected to allow of detailed study of horizontal changes, and consequently the vertical detail has had to be sacrificed to some extent. It is the authors' contention that for *some* purposes and in *some* areas such a distribution of effort is more productive and economic than the more conventional survey with a larger number of observations per station, and that the ability of the bathythermograph to record the large summer discontinuities makes such a policy practicable even in that season.

The detailed results¹⁾ of the hydrographic observations are presented here in the form

¹⁾ The April survey was described to the North Sea Committee in September 1952, when copies of the hydrographic observations were circulated.







of charts for each observation depth (Figs. 11 and 12). The significant features of the plankton distribution are also presented as charts (Fig. 12). The survey was carried out in two parts, a northern section by F.R.S. "Scotia" from 19. to 22. April 1952, and a southern one by F.R.S. "Clupea" from 14. to 18. April. Each of these surveys was worked from north to south, and there is thus a gap of seven days between the working by "Clupea" of the line $58^{\circ}25'N$. and the incomplete line, $58^{\circ}35'N$. of "Scotia's" survey, which was abandoned in severe weather. The writers have, therefore, had to consider carefully the legitimacy of drawing conclusions from the rather marked changes which appear on this boundary. They have decided to present the charts as if the surveys had been simultaneous but it is necessary that this time discontinuity be borne in mind in examination of the charts. It is indeed fortunate that our main conclusions are not dependent on this feature but can be deduced from the study of variation along the east-west lines, each of which was completed in less than one day.

Taking other work into account, the distribution of physical and chemical properties suggests that:—

1. (a) There was appreciable inflow through the Orkney-Shetland Channels between 30 m. and bottom at the time of this survey.
- (b) This inflow was through the centre of the Channel, i.e., on both sides of Fair Isle, and produced high temperatures at these depths as far south as the latitude of Fraserburgh.
- (c) There was a considerable salinity gradient across this stream, the lower values lying to the west.
2. There was a flow of warm surface water of unknown origin into the area from the eastward in about the latitude of Fraserburgh, and the confluence of these streams produced a patch of generally high temperature north of Fraserburgh, and east of Wick.
3. The main body of Atlantic water deriving from the north of Scotland was situated to the east of the Orkney-Shetland water, and was of similar salinity but markedly lower temperature.
4. The upper water layers do not show a distribution of properties clearly enough to allow of firm conclusions being drawn

from the hydrographical factors. The following deductions are therefore highly tentative:—

- (a) Warm surface water appeared to enter the North Sea principally to the south of Fair Isle and not to proceed south of the latitude of Wick.
- (b) This surface water was met by Moray Firth surface water to its west and by the thrust from the south-east mentioned in (2) and consequently was diverted and flowed out to the eastward in about the latitude of Wick.

To emphasize the main conclusions, it seems from the distribution of physical features that there was at the time of this survey a distinct inflow of warm water through the Orkney-Shetland Channels, and that this effect was most marked at 30 m. and below. The effect seems to be less than suggested by SMED, as this water appears not to extend eastward beyond about $1^{\circ}30'W$. A more serious contrast with SMED's conclusions might be the realisation that the most marked inflow was a deep one. This, of course, is the reverse of what would be obtained by dynamic study where the lowest isobaric surface is taken as a level one.

Turning now to the Hensen-net collections, which take no account of vertical distribution, the total volume of plankton (exclusive of medusoid forms) has been measured for each net haul, and an eye examination has been made and the important organisms assessed for each sample. This gives the main features of the plankton distribution, and the volumes per haul are presented in Figure 12. It will be seen that high plankton volumes were found principally in two distinct tongues, the larger penetrating the North Sea from south of Fair Isle; the second, less distinct, one in a position which suggests its association with the Atlantic inflow via the north of Shetland. The second tongue was not sufficiently surveyed on this occasion to draw any firm conclusions about it. The area is one of uniformly high salinity and there is nothing in the phosphate values to suggest that there can have been a vernal phyto-plankton bloom by this time. It is interesting to note that *Cosmetira* was detected only in the area of the warm stream, in contrast to the colder east of Shetland intrusion which was characterised by *Physophora*. Both these organisms are used as indicators of water which contains oceanic elements and were similarly distributed in 1947 (FRASER 1952).

The main tongue of rich plankton consisted largely of *Calanus* and very nearly coincided with the tongue of inflowing water as deduced from the hydrographical data. It does, however, lie largely to the south of Fair Isle, i.e., where the hydrographical data would suggest an inflow above 30 metres, and not on both sides of Fair Isle where the deeper inflow is suggested.

The August Survey.

This was designed to give a similar coverage to that of the April survey, but since a third vessel was available — the Herring Industry Board's "Silver Scout" — opportunity was taken to extend the area both eastwards on to the Fladen Ground and westwards into the Moray Firth. The hydrographic observations¹⁾ are presented in Figure 13. It has not yet been possible to assess the plankton data for this survey.

"Scotia", working to the north and east, was operating from 6. to 11. August 1952, "Clupea" on the central section from 4. to 8. August 1952, and "Silver Scout" to the west from 6. to 8. August 1952. The period 8. to 11. August 1952 was a stormy one, and perhaps for this reason the fit between the two ships' observations on the line of the prime meridian is not a good one. "Scotia", working a few days later, found temperatures at surface and 10 m. which were almost 1° lower than those found by "Clupea". The isotherms in this region should be regarded as approximate.

The major hydrographic features can be to a large extent explained on the basis that turbulent mixing has taken place inshore to a much greater degree than offshore, and that mixing has been particularly strong in the region to the northward of Fair Isle. For instance, free phosphate at 10 m. had moderate values of the order of 0.3 µg. at./l. within about 50 miles of the coast, while everywhere to the eastward the values were less than 0.1. Upper water temperatures were similarly low in this area, except in the shallower water to the south. Bottom temperatures were, as one would expect, high inshore, while there was a very steep gradient from east to west in the Fair Isle region. To the north and east of the area, bottom temperatures had not changed during the summer.

The highest salinity values, both at surface

and bottom, lay in a north-south tongue from the east of Shetland to the Fladen Ground. This would appear to represent the main oceanic inflow in the area surveyed, and this confirms the impression stated above that whatever flow occurs via the Orkney-Shetland channels has no marked effect to the east of 1° west longitude.

As in the April survey, the "oceanic" tongue consisted of patches of high salinity water rather than a massive homogeneous body. The pattern of these patches was similar in the two surveys, but it is felt that this could have been fortuitous and further data are needed. It will be of interest to see whether this very obvious high salinity area, extending as it does from about 59°40'N. to 58°N., proves to be a consistent feature.

Further repetition of work in this area, associated with a similarly detailed survey of the relatively unstudied area 50—60 miles west of the Shetland and Orkney Islands, should produce a more precise picture of the plankton and hydrographical features and give further enlightenment on the problem. We should then be in a position to speculate on how far the course of the east coast herring fishery may depend on the fluctuations of this Fair Isle stream.

R. E. CRAIG, T. LOVEGROVE

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¹⁾ See Footnote p. 107.

Plankton.

The Continuous Plankton Recorder Survey: The Plankton around the north of the British Isles in 1952.

The Recorder Survey was continued during 1952 by the Scottish Marine Biological Association, from the Edinburgh laboratory. The scope of the survey was similar to that in previous years, and these figures and notes are provided for comparison with the series of summaries arranged in the same way for 1948, 1949, 1950 and 1951 (Ann. Biol. 5, 6, 7, and 8).



Figure 14. A chart showing the routes along which the Continuous Plankton Recorder was usually towed monthly during 1952. The routes indicated by the heavier line, i.e., H & J, W, X, V, T, A, and K, are those selected for this summary. The dotted line marks the position of the 200-fathom contour.

The routes on which the Plankton Recorder was towed each month, when sailing schedules permitted, are shown in Figure 14. During the first four months of the year, the Netherlands Weather Ships did tours of duty on Weather Station "Kilo", and as a result it has been necessary to combine the two routes H and J (Figure 14) in the illustrations for 1952. In

each case the histograms from January to April are computed from route H, and the subsequent ones from route J. Further details of the plankton caught on routes H, J, W, X, V, T, and K, and also on M, C, G, B, and R, which are not used in these summaries, can be obtained from the Oceanographic Laboratory at 78, Craighall Road, Edinburgh. Again it should be stressed that all the samples were taken at a single depth of 10 metres below the surface. No allowance has been made for diurnal migration, or for the considerable fluctuations in the quantity of plankton taken along the length of each tow. Indeed, the figures are intended only as broad summaries of the variations found; they give the average number of animals caught on a route in each month based on the theoretical quantity of water passing through the Recorder, which is presumed to be of the order of $2\frac{1}{2}$ cubic metres per 10 miles of tow.

The very gross estimate of phytoplankton based on the colour of the silk (Figure 15) brings out again points which have been noticeable in previous years, and which might well be expected. There was a widespread outburst of diatoms in the spring; May apparently being the most productive month. The spring outburst in the North Sea (K route) was again earlier than over the deeper Atlantic water; in March and April, as compared with May. However, on the coastal ends of the Atlantic routes (W and X), that is to the shoreward side of the 200 fathom contour, conditions were more like those in the North Sea; phytoplankton first appeared there in March. An unusual feature in 1952 was the persistence of autumn flowering, shown by "greenness" on the X route as late as December, and the strong crop in the North Sea, K route, in November.

For "total copepods" also, the coastal conditions in the North Sea (open histograms — Figure 16) approximated more closely to those in the North Sea; the spring population from April to June was, in the main, more successful than the autumn one. The relatively very large numbers of copepods found well out to sea on W and X from July to September were almost exclusively *Acartia clausi*, which suggests a return to the conditions found in 1948

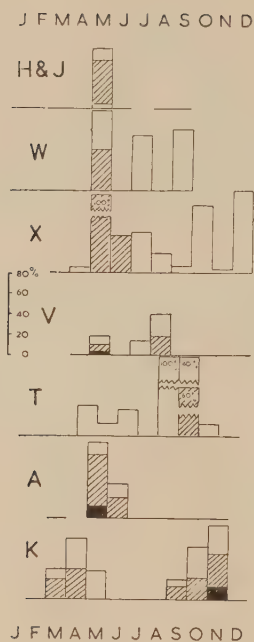


Figure 15.

Figure 15. An estimate of the density of *Phytoplankton* month by month on the Recorder routes, H & J, W, X, V, T, A, and K. The histograms show the percentage of the route which sampled water containing various quantities of phytoplankton as estimated by comparing the colour of the filtering silk with an arbitrary colour scale; only that part of the tow taken outside the 200-fathom contour is included on routes H & J, W, X, V, and T. The open part of the histogram represents 'pale green', the hatched part 'green' and the blacked part 'dark green'. A gap in the base line indicates that no data were available in the particular month.

Figure 16. Histograms representing the relative numbers of *Total Copepoda* (all species combined) taken month by month on the Recorder routes H & J, W, X, V, T, A, and K. The values represent the number of copepods per cubic metre either for the whole length of tow on lines A and K or for the two parts of the tow which lie on either side of the 200-fathom contour on lines H & J, W, X, V, and T when the solid histogram shows the numbers over the deeper water and the open histogram over the shallower or coastal water. A gap in the base line indicates that no data were available in the particular month.

and 1949. *A. clausi* was also abundant further north on the T route in late September, but *Temora longicornis* contributed appreciably to this population. It may be thought surprising that densities of 2000 to 3000 copepods per cubic metre should be found near the surface 300 to 400 miles off shore over deep water, especially if this proves to be a regular phenomenon, as now appears likely. Only rarely are such high numbers found elsewhere in the

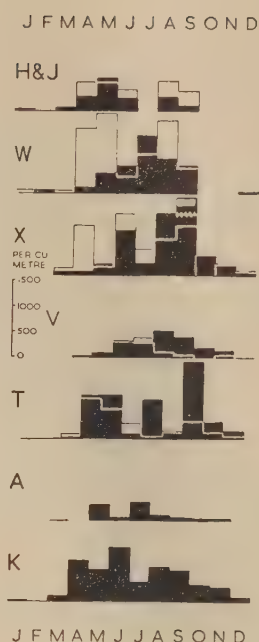


Figure 16.

Recorder survey even over shallower water in the North Sea.

The distributions of *Calanus* (Figures 17 and 18) show features which we have come to expect from the previous summaries. The predominance of this copepod and its long season on the T route bring out its northerly distribution. Elsewhere it thrives chiefly in coastal or "mixed" conditions, within the 200 fathom contour on W and X, and on the K route during the major spring generation in the North Sea.

Euchaeta spp. (Figure 19) were restricted to samples taken over deeper water. Superficially it would appear that the season for *Euchaeta* was somewhat later to the north than in the south. Such a conclusion would conform to the trend found in other forms (see below) but whereas only *E. norvegica* was found in the north *E. hebes* was the commoner species on routes H, J and W.

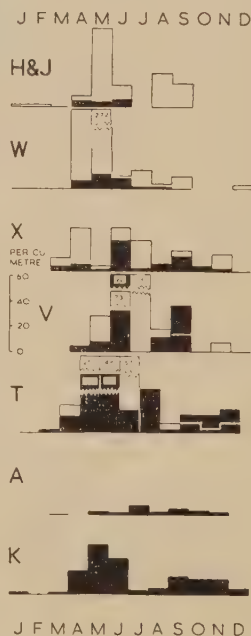


Figure 17.

Figure 17. Histograms representing the relative numbers of *Large Calanus* (copepodid stages V and VI) taken month by month on the Recorder routes H & J, W, X, V, T, A, and K. Details as in Figure 16.

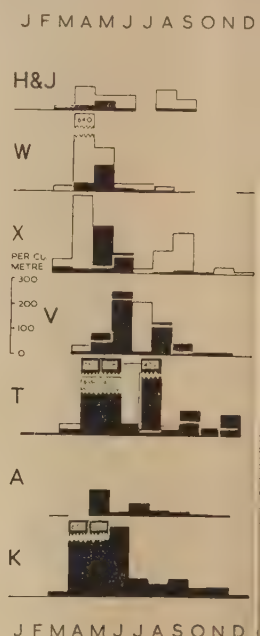


Figure 18.

Figure 18. Histograms representing the relative numbers of *Calanus* (all stages combined) taken month by month on Recorder routes H & J, W, X, V, T, A, and K. Details as in Figure 16.

The arrangement of the data in this summarised form in each of the past five years would suggest that there has been a steady, if slight, increase in the numbers of *Metridia lucens* over the period (Figure 20). Taking the two routes which have been sampled consistently, one finds that the scale which allows for numbers up to 3 per cubic metre was adequate in 1948 and 1949. In 1950 numbers of the order of 4 and 5 per cubic metre were found in the spring, and higher numbers have been taken more and more frequently since then, reaching maxima of 10 and 11 per cubic metre in July and April on the W route in 1951 and 1952 respectively. It should be explained that in these estimates of *M. lucens* only those specimens large enough to be easily recognisable to the naked eye are counted, so the figures only include adults and copepodid stage V. The fact that the younger stages are

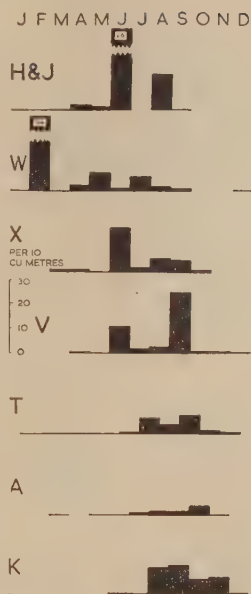


Figure 21.

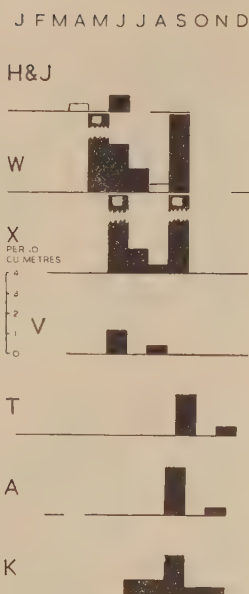


Figure 22.

Figure 21. Histograms representing the relative numbers of *Limacina* (only those individuals larger than 1 mm. included) taken month by month from the Recorder routes H & J, W, X, T, V, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes H & J, W, X, V, and T.

Figure 22. Histograms representing the relative numbers of *Clione limacina* (solid) and *Clione clione* (open line) taken month by month on the Recorder routes H & J, W, X, V, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes H & J, W, X, V, and T.

omitted may account for the sharp fluctuations with time on the Atlantic routes; the "peaks" indicating successive generations approaching maturity. But, be this as it may, one cannot fail to obtain from the histograms the impression of a succession in the times of abundance of *Metridia* as one reads from the Atlantic routes round into the North Sea; that is, from the top of the figure towards the bottom.

Little additional comment is required here on the distributions of *Limacina* (Fig. 21), *Clione* (Fig. 22), or *Tomopteris* (Fig. 23); their abundance and times of occurrence in the catches agree well with previous experience in the survey. *Clione* (Fig. 22) was restricted to the southern Atlantic routes as it was in 1951; this can be compared with 1948 when it was found in considerable numbers as far north as the V route in August, and with 1950 when it reached the coast of Norway in late autumn.

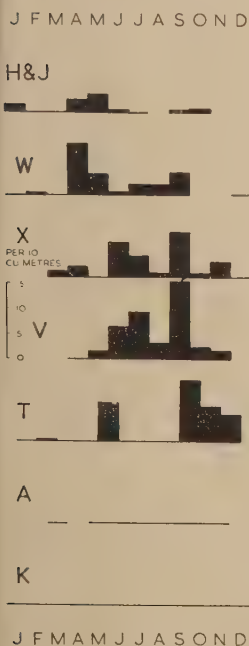


Figure 19.

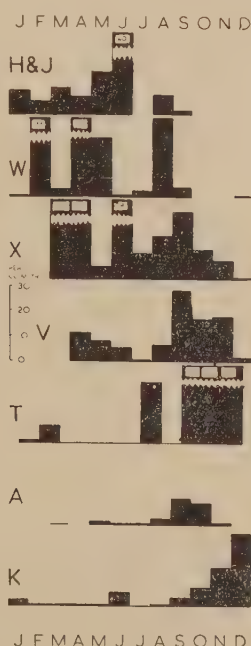


Figure 20.

Figure 19. Histograms representing the relative numbers of *Euchaeta* spp. taken month by month from the Recorder routes H & J, W, X, V, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes H & J, W, X, V, and T.

Figure 20. Histograms representing the relative numbers of *Metridia lucens* taken month by month from the Recorder routes H & J, W, X, T, V, A, and K; only that part of the tow taken outside the 200-fathom contour is included on routes H & J, W, X, V, and T.

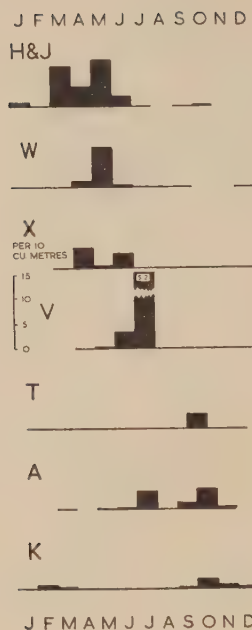


Figure 23.

Figure 23. Histograms representing the relative numbers of *Tomopteris* taken month by month on Recorder routes H & J, W, X, V, T, A, and K; only that part of the tow taken outside the 200-fathom contour is included on the routes H & J, W, X, V, and T.

Figure 24. Histograms representing the relative numbers of *Thaliacea* taken month by month on Recorder routes H & J, W, X, V, T, A, and K. On routes H & J, W, X, V, and T the solid histogram shows the numbers over the deeper water, outside the 200-fathom contour, and the open histogram those over the shallower or coastal water.

Thaliacea (Fig. 24) were again plentiful in the southern Atlantic from May to September, probably more so than in our previous experience; that is, since 1948. Unusually high numbers of *Salpa fusiformis* were taken on the A route in September and October, and a few were also recorded on the M route in October, near the Pentland Skerries. Those which reached the T route at about the same time were found close inshore near the coast of Norway, as in 1951. It is surprising that so few *Thaliacea* were taken on the V route. In August they were found only over shallow water, some 60 miles inside the 200 fathom contour, at the point where the Recorder was shot, and it is possible that more might have been found if this V record had started nearer the coast. There is the possible explanation that the *Thaliacea* were driven shorewards as they were in 1951, and that they subsequently

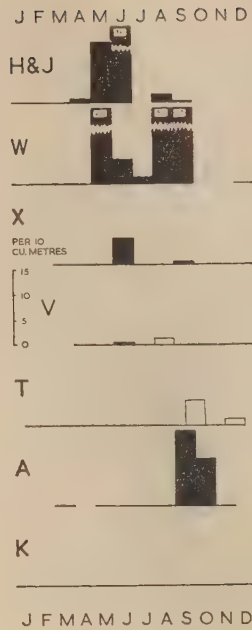


Figure 24.

entered the North Sea through the Fair Isle channel. Such a suggestion would account for their abundance on the A route, which cuts across this entrance, their appearance on the western end of the M route, and also their failure to reach the K route, which crosses the main southerly drift in the northern North Sea.

Several times in previous summaries we have drawn attention to the apparent succession in time of the "indicator" forms on the histograms as one moves from the more southerly Atlantic routes northwards to the T route or into the North Sea. Returning to *Metridia* (Fig. 20), we find that the arrangement in 1952 is again similar to that found in 1949, 1950 and 1951. One is tempted to identify the larger numbers found on W and X between February and April with the small increases in numbers on A and K somewhat later in May and June. Later, there appears to be a second succession, starting in the Atlantic in May and June and reaching the T route in late July and the A route in September. Later still, possibly, yet a third succession starts on W and X in August and September and culminates on K as late as December. Although this may seem to be too exact, or tidy, an interpretation to put on a preliminary examination of summarised results, some superficial confirmation can be derived from the other "indicator" forms illustrated. They all demonstrate clearly the left-to-right shift, or the succession in time, as one reads down the figures. *Limacina* (Fig. 21) shows an analogous sequence to *Metridia* in the summer as indeed it has done in previous years, and to some degree the same is true of *Clione* (Fig. 22), *Tomopteris* (Fig. 23), and the *Thaliacea* (Fig. 24).

Undoubtedly an arbitrary procedure of identifying a peak or concentration on one route with the peak immediately succeeding it in time on the next route to the north is both speculative and dangerous. At the best one cannot expect these histograms of averages to provide complete agreement in the time successions between the different forms, or, for that matter, an even and regular sequence for any particular "indicator". A more convincing case, it is believed, can be made by an analysis of the detailed charts of the month to month distribution. Nevertheless, taking the histograms for 1952 together with those presented in previous summaries in the *Annales Biologiques*, one is tempted to adopt as a working

hypothesis the suggestion that two, if not three, waves or successions of "indicator species" (or alternatively, of conditions conducive to the increase in the local stocks of these forms) pass round the British Isles each year. Accepting this as a working hypothesis it would appear from the histograms that it takes some four or five months for each wave to cover the distance from the region of the southern Atlantic routes to the T or K routes, which necessitates a speed of the order of six to eight sea-miles per day. Such a speed might be considered reasonable for the residual movement of the surface waters in the Atlantic drift.

It is by no means easy to visualise a mechanism which would give rise to such successive waves or pulses of plankton in what must be considered to be a more or less continual movement of water. If one could believe that the animals concerned have their natural or most favourable environment somewhere to the south of our area, that is, further back along the path of the drift, then one might postulate that the three waves of higher numbers were no more than the result of successive and distinct generations being carried away from this main centre of abundance in a more or less steady current. But, in view of what is known of the distribution of the animals concerned, such a simple explanation hardly meets the case. However it would be premature to discuss this question in any detail here, with the limited data presented. We hope to consider the matter more fully in a *Bulletin of Marine Ecology* in the near future.

In June an unusual occurrence of *Pleuromamma robusta* was recorded in the region of the A route. A few specimens of this copepod were found in the stomachs of herring which had been caught in the region of 58°N., 01°W. This is the first record we have had of *Pleuromamma* so far south in spite of the intensive plankton sampling that has been carried out on the herring grounds each year since 1946. It may be significant in this respect that June was the only month in which *Rhincalanus nasutus* was taken on the A route. *Rhincalanus* was nowhere abundant at 10 m. during 1952, although it occurred spasmodically from April to September on J, W and X, and on V in May.

K. M. RAE

Scottish Plankton Investigations, 1952.

Plankton samples were taken by Scottish vessels in 1952 throughout the year in the North Sea and adjacent waters, and frequent samples were also taken in the Faroe Channel and in June off the Scottish west coast. The Faroe Channel collections are briefly described in the North-Western Area report, but as these and west Scottish collections were made as part of an examination of the waters which affect the North Sea they are necessarily also referred to here when considering the ultimate distribution of oceanic plankton in the northern North Sea.

The early spring outburst of diatoms off the east Scottish coast was dominated by *Skeletonema* in March, but also in abundance were *Halosphaera*, *Rhizosolenia shrubsolei*, *Thalassiothrix nitzschoides*, *Nitzschia seriata*, *Paralia*, etc.: by April the *Skeletonema* had died down and was replaced by *Thalassiosira gravida*. The diatom population in general died down about the middle of May and was replaced by dinoflagellates (*Ceratium* spp.), tintinnids and radiolaria. The autumn recurrence started early and even by the end of July *Rhizosolenia alata* was becoming abundant in coastal areas though it was not widespread until the end of August. It continued until October in the central North Sea.

Calanus was scarce in early spring in the northern North Sea, especially in the Moray Firth, but by April and May much greater concentrations of *C. finmarchicus* were found on the Fladen and in the Fair Isle and Shetland areas. These were maintained and extended throughout the summer to the east Scottish coast. Summer investigations showed this species to be abundant also north-west of Scotland over the continental shelf but very scarce over the deep water off the edge of the shelf. *C. helgolandicus* was mixed with *C. finmarchicus* in varying proportions over the whole of the shelf area but none was taken over the deep water between Faroe and the Butt of Lewis or near Faroe. A few specimens, probably originating off the west or north Scottish coast and becoming mixed with the inflowing stream, were carried to the eastern end of the Shetland line of stations and even beyond to as far as 62°N. 1°W. Very dense concentrations of *Limacina* were found in the Minch in June.

Some *Rhincalanus*, *Thysanoessa longicaudata*, *Physophora* and *Sagitta serratodentata* were still to be found in the first months of the year in the northern North Sea, particularly to the east of Shetland, and represent the survivors of the previous autumn's inflow. These, except for *Th. longicaudata*, gradually died out and were not replaced until quite late in the year (see below). Throughout the spring and summer the northern North Sea plankton was typically coastal. *Thysanoessa longicaudata* persisted with *Th. inermis*, *Nyctiphanes couchii*, *Calanus*, etc., and *Sagitta elegans*, though *S. elegans* was not abundant until autumn. In addition larval forms were very numerous, especially plutei and post-larval polychaetes with abundant *Actinotrocha* and larger numbers of *Tornaria* than usual in August. Although the oceanic species were little in evidence, nevertheless *Sagitta setosa* was kept well south and its distribution was in fact typical of a year of good Atlantic inflow. This would suggest a good penetration of water from the continental shelf area west of Orkney and Shetland, and indeed there appeared to be a contiguity of the plankton community of the west and north Scottish coastal belt with that of the Moray Firth and Fladen and east Scottish coast generally.

Oceanic species were abundantly represented off the edge of the continental shelf, (see North-Western Area and Atlantic Slope reports), and could be separated into Atlantic, Lusitanian and boreal communities. Of these the Lusitanian stream was probably of the greatest interest and it could be traced at 750—250 m. depth along the edge of the shelf from north-western Ireland, east of Rockall, south of the Wyville-Thomson Ridge and crossing the Faroe-Shetland line to the north-west of Shetland. This stream could be recognized by the presence of many oceanic species, typically the siphonophores *Hippopodius hippopus*, *Cheilophyes appendiculata*, *Chuniphyes multidentata*, *Lensia conoidea*, *L. fowleri*, *Vogtia spinosa*; with *Sagitta lyra*, *Clio pyramidata*, *C. cuspidata* and *Diacria trispinosa*; the polychaetes *Vanadis formosa* and *Callizona angelini*; the cephalopods *Tracheloteuthis risei* and *Taonidium pfefferi*; bathypelagic copepods and decapods, etc. etc. Off the Irish coast this community was even richer in exotic forms and included *Nectopyramis thetis*, *Veleva*, *Bassia bassensis*, *Sagitta macrocephala*, *Carinaria lamarkii* and *Arachnomysis leukarti*, but of these extra forms

only *Nectopyramis* and *Arachnomysis* were found at the entrance to the Faroe Channel and none penetrated to the Faroe-Shetland line. Some doliolids (*D. gegenbauri*) were found off the Irish and west Scottish coasts, but unlike many previous years they died out very early and none was found in the northern part of the area surveyed or in the North Sea. *Salpa fusiformis* on the other hand thrived and penetrated into the North Sea (see below) but a few *Ihlea asymmetrica*, like the doliolids, soon perished.

Above this Lusitanian stream was a community of Atlantic species — *Sagitta serratodentata*, *Rhincalanus nasutus*, *Eucalanus elongatus*, *Thysanoessa longicaudata*, *Agalma elegans*, *Physophora*, *Galettia biloba* (= *australis*), and the radiolarian *Thalassicolla*, and these forms were also found in the upper layers north of the Wyville-Thomson Ridge. In the deeper water, both sides of the ridge, was a boreal community containing *Calanus hyperboreus*, *Metridia longa*, *Sagitta maxima* and *Eukrohnia hamata*. This community was more in evidence on the north-western side of the Faroe-Shetland line than elsewhere in the survey but nevertheless was present in deep water as far south as the north-west of Ireland.

As in previous years the fauna of the Faroe Channel and its approaches affected the North Sea by two distinct routes; via the north of Shetland and via the Orkney Passage. Very little oceanic fauna entered the North Sea by either of these routes until August when *Salpa fusiformis* came in via the Orkney Passage and was fairly abundant and thriving in places east of the Moray Firth in September and east of Aberdeen in October. Both aggregate and solitary forms were present and were in excellent condition when caught. Salps also penetrated via the north of Shetland in August but very slightly and only to the east of 2°E. By November the Lusitanian fauna, somewhat modified by the absence of less tolerant species, was abundantly represented to the north-west of Shetland and even such exotic forms as *Vanadis formosa*, *Vogtia spinosa* and *Hippopodius* were found amongst the more usual species. In December all collections in the area between Shetland and Norway contained oceanic species, *Hippopodius* being most surprisingly abundant with *Agalma*, *Lensia*, *Dimophyes*, *Galettia*, *Clio*, *Taonidium* and *Thalassicolla*. This fauna was however confined to this area of the North Sea and apart from

a few specimens of *Agalma* the oceanic species were not found in Moray Firth or off the east Scottish coast in December.

J. H. FRASER

The Dry-Weight and Fat Content of Plankton with Estimates from Flagellate Counts.

Hensen-net plankton.

Dried Hensen-net plankton samples were collected from the Flamborough Line stations in 1950, 1951, and 1952 for certain months of the year. The dry weights and fat weights expressed as milligrammes per m.³ together with the fat percentages are shown in Figure 25. As earlier results showed that most of the production took place between April and September, attempts to obtain samples each month of the year were abandoned after 1950 in favour of the shorter period.

The contours in Figure 25 indicate a build up in all values between May and July for the years dealt with and in this respect the picture is similar to that formed as a result of the observations in earlier years published in Volumes IV, V, and VI of this journal. There is, of course, no evidence of the autumn period of production which was evident when the observations were made throughout the year. Another tendency in the temporal distribution of the dry weight and the fat weight which was also apparent in earlier years is that of the higher values occurring first at the stations farthest offshore.

Deficiencies in sampling make it difficult to compare the different years, but it would appear that dry weight and fat weight were higher in 1952 than in the previous year. With regard to the percentage of fat, it will be seen that the individual values did not rise so high in 1952 as in 1951 and 1950.

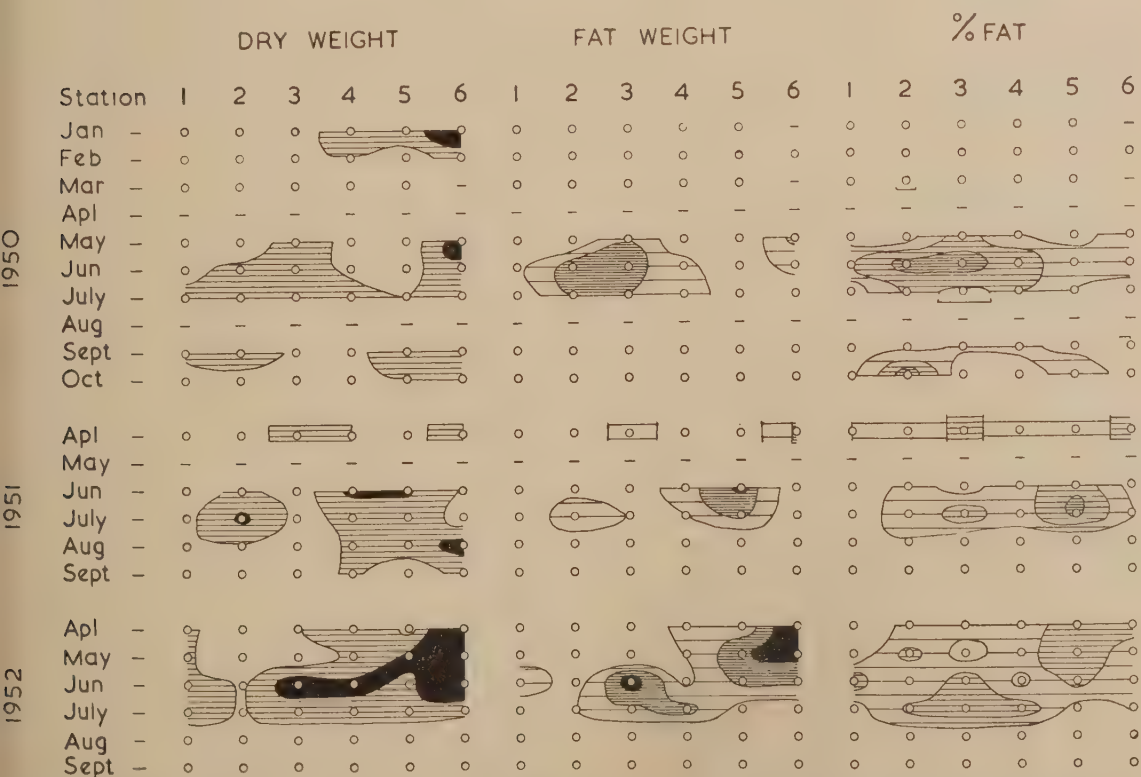


Figure 25. Dry weight, fat weight and percentage fat from six stations between Flamborough Head (Station 1) and the south-west patch of the Dogger (Station 6). The dry weights are contoured at 50 (medium-spaced lines) and 100 (black) mg. per cubic metre, the fat weights at 5 (wide-spaced lines), 10 (medium-spaced lines) and 20 (black) mg. per cubic metre and the percentages of fat at 10 (wide-spaced lines), 20 (medium-spaced lines) and 30 (close-spaced lines).

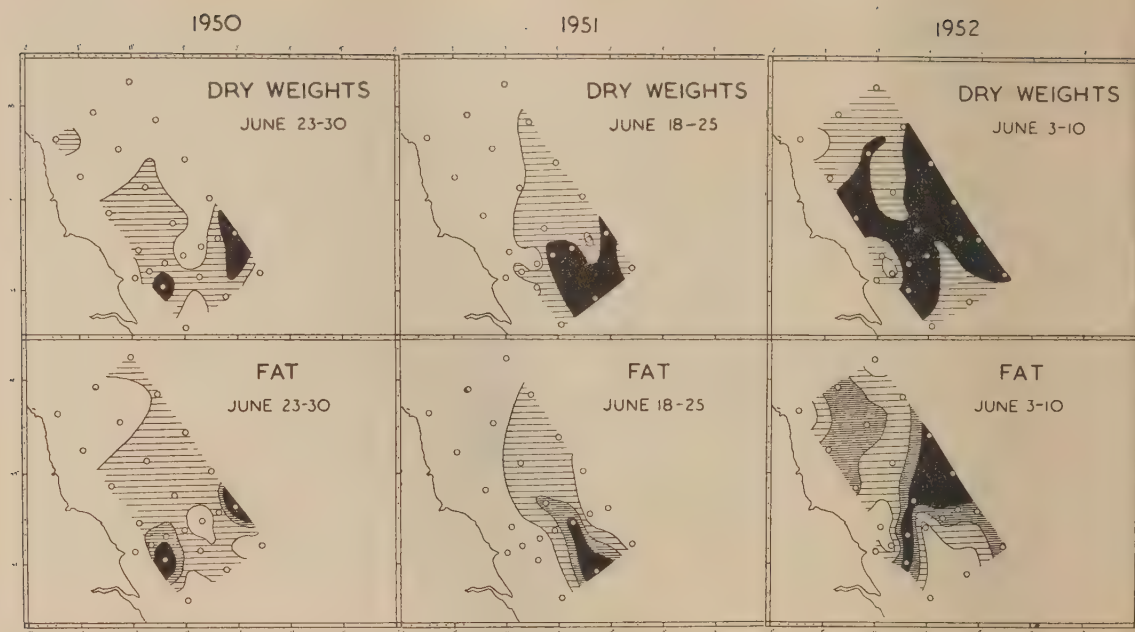


Figure 26. Charts showing the distribution of the standing crop of dried Hensen-net plankton per m.³ (above) and the weight per m.³ of the fat in the plankton (below). The dry weights are contoured at 50 (medium spaced lines) and 100 (black) mg. per m.³. The fat weights are contoured at 10 (medium spaced lines), 20 (close spaced lines) and 30 (black) mg. per m.³.

A grid of comparable stations including the Flamborough Line has been carried out off the north-east coast of England for a number of years and the dry weights and fat weights per m.³ for each Hensen-net station for the years 1950, 1951 and 1952 are contoured in Figure 26 and tabulated in Table 8. Both for dry weight and fat weight the year 1952 is shown as outstanding while 1950 and 1951 are similar for dry weight but 1951 is poorer than 1950 for fat weight. When weighted averages are taken for dry weights and fat weights in respect of twelve stations north of the Flamborough Line for the years since 1947, the results compare as follows:—

	Dry Weight mg. per m. ³	Fat mg. per m. ³
1947.....	55	18
1948.....	46	12
1949.....	44	9
1950.....	43	11
1951.....	43	8
1952.....	97	20

It will be seen that 1952 was the best year in the series for both dry weight and fat weight, whereas 1951 was generally a poor

year, being the worst for fat and sharing the lowest dry weight value with 1950 followed in importance by 1949 and 1948.

At this juncture it may be useful to express the standing crop of plankton, expressed as dry weight under a square metre in the area considered, with corresponding figures from elsewhere. Taking the year as a whole, it is possible to give an average value for station 3 of the Flamborough Line which was sampled each month in 1947 and for which the depth sampled varied between 45 and 64 metres. This figure is 1.73 g., the lowest value being 0.64 in August and the highest 3.84 in September. It compares with values of 1 to 1.7 g. dry weight under a square metre at 50 metres depth taken at a station 4 miles from Plymouth by HARVEY (1) in 1949, but is much less than this worker's results in 1934 when the "organic matter" (circa $\frac{3}{8}$ of dry weight) went up to over 5 g. for the zooplankton collected. It is still less than the dry weights of zooplankton found below a square metre in the Gulf of Maine (2) which reached 30 g. in May and thereafter remained at 12 g. for some months. The North Sea value is, however, above that

Table 8. Fat and Dry Weights per m.³ for Hensen-Net Hauls in mg.

1950					1951					1952				
"Sir Lancelot", Cruise XI, 23.-30. June					"Sir Lancelot", Cruise X, 18.—26. June					"Sir Lancelot", Cruise XI, 3.—10. June				
Stat.	Lat. N.	Long.	Dry Weight	Fat	Stat.	Lat. N.	Long.	Dry Weight	Fat	Stat.	Lat. N.	Long.	Dry Weight	Fat
1	53°35'	1°00'E.	28	4	1	55°14'	0°58'W.	12	1	1	53°36'	1°04½'E.	90	7
2	53°55'	1°46' -	72	14	2	55°39'	1°29' -	25	2	2	53°53½'	1°46' -	70	4
3	54°12'	2°25' -	29	6	3	55°55'	0°45' -	18	1	3	54°11'	2°38' -	106	25
4	54°38'	1°56' -	228	56	4	56°14'	0°01' -	22	1	4	54°35½'	1°58' -	134	23
5	54°34'	1°38' -	71	13	5	55°50'	0°29'E.	53	11	5	54°34'	1°37' -	157	22
6	54°28'	1°17' -	41	5	6	55°33'	0°15'W.	42	9	6	54°29'	1°17' -	98	22
7	54°23'	0°58' -	40	11	7	55°25'	0°59'E.	72	11	7	54°23'	0°57' -	108	8
8	54°18'	0°38' -	83	28	8	55°08'	0°16' -	50	12	8	54°18'	0°38' -	140	36
9	54°13'	0°19' -	70	25	9	54°50'	0°25'W.	34	6	9	54°12'	0°18' -	48	5
10	54°08'	0°02' -	37	7	10	54°26'	0°04'E.	40	8	10	54°08'	0°00' -	76	16
11	54°27'	0°06' -	53	16	11	54°43'	0°45' -	93	20	11	54°25½'	0°05' -	51	3
12	54°44'	0°47' -	55	18	12	55°01½'	1°28' -	89	9	12	54°42½'	0°47' -	111	32
13	55°02'	1°29' -	38	10	13	54°38'	1°56' -	105	7	13	55°00'	1°29' -	245	78
18	55°25'	1°00' -	37	10	14	54°33½'	1°37' -	50	3	14	55°24'	1°01' -	151	31
19	55°08'	0°14' -	56	17	15	54°28½'	1°18' -	106	31	15	55°49'	0°30' -	99	17
20	54°51'	0°25'W.	51	12	16	54°20'	1°15' -	171	41	16	56°13½'	0°02'W.	78	6
21	55°15'	0°58' -	30	8	17	54°23'	0°58' -	108	16	17	55°56'	0°45' -	95	26
22	55°33'	0°14' -	18	5	18	54°18'	0°38' -	27	2	18	55°38½'	1°28' -	23	3
23	55°51'	0°28'E.	44	10	19	54°12½'	0°19' -	59	7	19	55°14'	0°55' -	86	21
24	56°14'	0°01'W.	33	12	20	54°08'	0°0' -	17	+	20	55°31½'	0°13½' -	101	26
25	55°56'	0°44' -	32	9	21	54°02'	0°34' -	50	3	21	55°06½'	0°18'E.	79	13
26	55°38'	1°25' -	65	8	23	53°37'	1°04' -	54	1	22	54°48½'	0°25'W.	134	20
28	54°03'	0°35'E.	126	40	24	53°55½'	1°44' -	228	42	24	54°00'	0°35'E.	154	32
29	54°09'	1°15'E.	53	14	25	54°14'	2°26' -	74	8					

of the northern Sargasso which maintained about 1.4 g. organic matter between July and September.

Finally a mention may be made of the sampling errors of the dry weight values from the Hensen-net hauls in the North Sea. Eleven hauls were made in quick succession at a station in the area discussed in 1950, the mean value being 100.7 mg. per m.³ and the standard deviation 13.65 mg. At a probability level of 0.05 therefore there would only be one observation in twenty which would exceed $\pm 27\%$ of the mean. In these circumstances it seems reasonable to have contoured the dry weight values at 50 and 100 mg. per m.³.

Flagellates and small algae.

For some of the stations of the June cruises of 1951 and 1952 counts of flagellates and small algae were made on the ship using a Stefi-Cole concentrator and haemocytometer (3). Their numbers are shown in Table 9 and their distribution in 1952 in Figure 27. The horizontal distribution suggests that they were more frequent in the coastal water and particularly in the south-western part of the grid. An examination of the numbers occurring at surface and bottom in the cruises of both years indicates that they were generally more important at the surface.

The majority of the flagellates were in the neighbourhood of 4 to 5 μ in length and egg-shaped. In order to make an estimate of the standing crop it was assumed that the population was made up of paraboloids having a long dimension of 4 μ and a short one of 2 μ giving a volume of $9.43\mu^3$. This number was brought up to the volume in μ^3 per mm.³ by multiplying by the frequency of occurrence of the organisms per mm.³ and then trans-



Figure 27. Chart showing the number of flagellates and small algae per mm.³ from surface samples at certain stations of "Sir Lancelot's" cruise XI (June 1952).

Table 9. Algae and Flagellates below 10 μ by Numbers per mm.³ and Dry Weight Estimates per m.³ in mg. with Hensen Dry Weights in brackets.

Station	Numbers			Dry Weight		
	Surface	Bottom	Mean	Surface	Bottom	Mean
"Sir Lancelot", Cruise X, 1951.						
4	23	19	21	22	18	20 (22)
6	18	13	15.5	17	12	15 (42)
7	7	5	6	7	5	6 (72)
10	13	11	12	12	10	11 (40)
11	7	7	7	7	7	7 (93)
12	14	7	10.5	13	7	10 (89)
13	8	10	9	8	9	8 (105)
20	14	—	—	13	—	— (17)
21	16	—	—	15	—	— (50)
"Sir Lancelot", Cruise XI, 1952.						
1	363	—	—	342	—	— (90)
2	212	—	—	200	—	— (70)
3	108	76	92	102	72	87 (106)
4	25	28	26.5	24	26	25 (134)
5	31	22	26.5	29	21	25 (157)
6	64	30	47	60	28	44 (98)
7	21	11	16	20	10	15 (108)
10	141	25	83	133	24	78 (76)
12	43	32	37.5	41	30	35 (111)
13	22	9	15.5	21	8	15 (245)
14	19	36	27.5	18	34	26 (151)
17	18	4	11	17	4	10 (95)
18	23	12	17.5	22	11	16 (23)
19	56	22	39	53	21	37 (86)
20	25	46	35.5	24	43	33 (101)
22	56	15	35.5	53	14	33 (134)

formed to mg. per m.³, the assumed wet weight being converted to dry weight by dividing by five. The figures so produced are in a form comparable with the Hensen-net dry weights with which they may be compared by consulting Table 9. The comparison is really one between the standing crop of zooplankton and the flagellates and small algae and it will be seen that the latter only amount to a modest proportion of the former, taking all the samples together the ratio is in fact 1:3.8 or about a quarter. This is in sharp contrast to the estimate of the total standing

crop of chlorophyll containing organisms of 4 g. estimated to have been present in the sea near Plymouth where the zooplankton crop was of a similar order of magnitude to that dealt with here. It looks, therefore, as if the larger diatoms may be responsible for the greater part of the standing crop of producers in our seas. Notwithstanding this somewhat modest proportion the flagellates and small algae may be more important than their standing crop value suggests owing to a more rapid growth rate and it is to be hoped that future work, particularly methods such as that employing the uptake of active carbon initiated by STEEMANN NIELSEN will enable us to find out how important is the role played by these small organisms in the production of the sea.

An inspection of Table 9 also brings out two other points. Firstly there seems to be an inverse trend between the flagellates and zooplankton which could, of course, be readily explained by grazing. For the pair of observations in 1951 the coefficient of correlation is quite high (-0.71) and would only be likely in chance conditions once in twenty times. In 1952 however, the inverse correlation was much lower (-0.301 from 16 pairs of observations) and would have been much more likely to arise by chance. Finally it is to be observed that, like the zooplankton, the standing crop and numbers of flagellates and small algae are substantially lower in 1951 than in 1952.

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R. S. WIMPENNY

THE FISH

Eggs and Larvae.

The Spawning of Anchovy and Pilchard in the south-eastern North Sea, with reference to climatic changes.

The quantitative plankton investigations carried out by the Biologische Anstalt Helgoland from the research vessel "Uthörn" in the German Bight, during the years 1948—52, show that a special change has arisen in the stock of fishes of the south-eastern North Sea. The anchovy (*Engraulis encrasicolus*), whose eggs were observed in former years only in a very small number (less than 25 per sqm.) off the east and north Frisian coast, now spawns widely in the German Bight and attains fry densities of over 1,000 (maximum 3,885) eggs per sqm. The spawning takes place principally in the open sea, in three places separated more or less from each other.

East Frisian spawning place. From Borkum Riff extending as far as the mouth of the Weser and Elbe. Maximum fry density 3,885 eggs per sqm.

Helgoland-Hever spawning place. Between Helgoland and the peninsula of Eiderstedt. Spawning density maximum 2,367 eggs per sqm.

Lister Tief spawning place. From Lister Tief to Horns Reef. Its importance is less than that of the two first-named areas. Maximum spawning density 459 eggs per sqm.

Wholly new is the occurrence of pilchards (*Clupea pilchardus*) as spawning fish in the south-eastern North Sea. The north-east border of its spawning area was hitherto represented by the Straits of Dover, beyond which eggs only seldom penetrated into the area of Sandetie, Bligh, and Hinder Bank. Since 1949, however, pilchard fry have been observed over the range of the "West Water", penetrating through the English Channel into the German Bight as far as Helgoland and the mouth of the Elbe; sporadic larvae have even drifted into the north Frisian waters. In the east Frisian area the density attained 588 eggs and 639 larvae per sqm.

An increase of the spawning stocks has also been observed in the common sole (*Solea vulgaris*), the mackerel (*Scomber scombrus*) and especially, the horse mackerel (*Caranx trachurus*):

Eggs per sqm.	1904—1930	1949—1952
Common sole.		
South-eastern North Sea . . .	10—35	100—276
Mackerel.		
South-eastern North Sea,		
within the 40-m. isobath . . .	40—65	45—69
without the 40-m. isobath . .	126—153	102—370
Horse mackerel.		
South-eastern North Sea . . .	23—77	100—846
		(exceptionally, in a single catch 2520)
Flemish Bight	50—460	
	(exceptionally, in a single catch 3650)	

These spawning increases in each case concern Mediterranean-Atlantic and Mediterranean-boreal species and are related to the increased penetration of Atlantic water into the North Sea (change of climate). One can conclude from the gradual increase of the catches, and from the frequency of the fry, that the changes did not proceed continuously, but in single pushes (perhaps according to the "submarine eages" of COOPER).

A detailed description is published in *Helgoländer Wissenschaftliche Meeresuntersuchungen*, 4, No. 3.

H. J. AURICH

Observations on Pelagic Fish Fry in the Jade Estuary during winter and spring.

Catches with the Petersen young-fish-trawl were made, as far as possible at least once a month, in the Jade area. From 1950 onwards, one catch near the surface and one near the bottom was made at each of five approximately equidistant stations in the Jade deep. The opening of the implement used by the shrimper "Seehund" had only about half the square of the normal net.

Table 10. Number of Pelagic Fish Fry

in five catches near the surface and five catches near the bottom, each of 10 minutes duration:

	Jan.	Febr.	March	April	May	June
a) Plaice larvae						
1949.....	..	—	..	..	—	—
1950.....	..	..	137 ¹⁾	..	8	—
1951.....	—	—	10	1	4	—
1952.....	—	8 ²⁾	28 ¹⁾	92 ¹⁾	2	—
b) Flounder larvae						
1949.....	..	—	..	..	—	—
1950.....	..	..	—	..	1	—
1951.....	—	—	—	—	—	1
1952.....	—	—	1 ¹⁾	537 ¹⁾	17	—
c) Herring larvae						
1949.....	..	48	..	..	316	25
1950.....	..	..	306 ¹⁾	..	544	—
1951.....	—	28	37	513	454	2
1952.....	1	25 ²⁾	305 ¹⁾	631 ¹⁾	1	—
	June	July	Aug.	Sept.	October	
d) Anchovy larvae						
1949.....	—	..	..	724	22	
1950.....	2	2643	..	—	—	
1951.....	—	78	4542	1405	5	
1952.....	1	531	2137	287	1	
e) Sole larvae						
1949.....	21	..	..	—	—	
1950.....	30	—	..	—	—	
1951.....	—	99	—	—	—	
1952.....	3	12	—	—	—	

¹⁾ Average of 3 cruises.

²⁾ Average of 2 cruises.

The quantity of plaice larvae (chiefly asymmetric stages) secured during the several years tends, as far as it goes, to show some covariation with the abundance of the bottom stages of the 0-group found during the same year.

It is of some interest to note that during the period under survey anchovy fry survived at least to the metamorphosis stages every year in the Jade area.

It might be recorded in addition that in May 1952 considerable quantities of sole and sprat eggs were found in the Jade, totalling about 13,000 specimens, each in 10 catches of our small young-fish-trawl. In former years, only insignificant numbers or none at all were taken. The number of larvae of the two species caught later in 1952 was by no means large, and the same holds good for the bottom stages of the sole in the autumn of 1952. The conditions of survival in the Jade seem to have been unfavourable.

A. BÜCKMANN

The Drift of Plaice Eggs in the Southern North Sea between 12. February and 22. March 1952.

For a number of species of fish the movements of the pelagic stages are roughly known, but in very few cases have detailed measurements of the drift of eggs and larvae been made. Even for the plaice it is still not known with any exactitude which parts of the continental nursery grounds receive the products of the Southern Bight spawning and which parts receive the products of the spawning which occurs between Helgoland and the Dogger Bank.

The series of plaice egg and larva surveys carried out in the southern North Sea now cover many years and it has been possible to make a series of estimates of the drift of the pelagic stages. The surveys in 1952 have particular significance as the German investigations from the "Gauss" were planned to coincide in time and area with the latter part of the plaice spawning period in order that direct measurements of the water movement would be available for this important period.

This note presents data on the drift of plaice eggs between mid-February and mid-March, thus covering the period in which the observations were made from the "Gauss".

The drift of planktonic organisms in the open sea can be ascertained by the use of successive surveys, provided the organisms are developing morphologically in a way that can readily be classified into stages and provided that the rate of development in relation to temperature is known. Developing fish eggs are particularly suitable for this method and the preliminary work on the rates of development has already been done by APSTEIN (1909) for plaice, flounder, dab, and cod.

In this account the drift of plaice eggs has been found over two successive periods of 19 and 17 days respectively, i.e., between 12.—16. February (cruise 3) and 1.—5. March (cruise 4) and then between 1.—5. and 20.—22. March (cruise 5) at a time when the temperature in the areas concerned was between 5.0°C. and 6.0°C. In 17 days the plaice egg at 5.5°C. develops from APSTEIN's stage 3 to APSTEIN's stage 23 which are the mid points of WOLLASTON's groups I and V (BUCHANAN-WOLLASTON 1923), groupings of stages which have been adopted here. Thus, comparing the distribution of group-I eggs on one cruise with that of group-V eggs on the

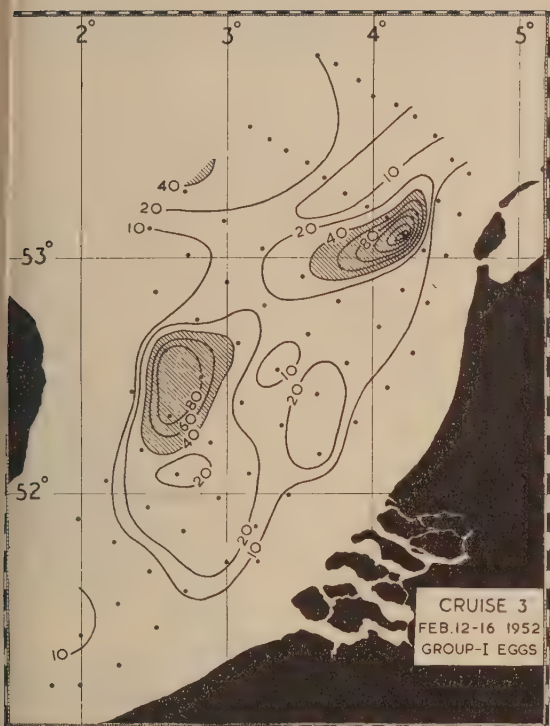


Figure 28.

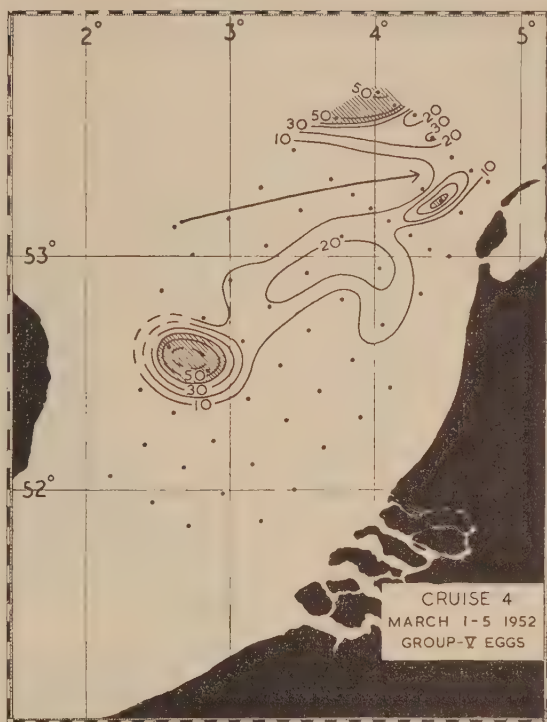


Figure 29.

following cruise gives the change in distribution of the very same eggs over the time interval between the pairs of surveys. The distribution of group-I eggs on cruises 3 and 4 and the distribution of group-V eggs on cruises 4 and 5 are given in Figures 28 to 31. The material has been presented as numbers per 1,000 m.³ so that the abundance of the same eggs on successive surveys is directly comparable, even if the eggs have drifted into areas of different depth.

Reduction in numbers from one survey (group-I eggs) to the next (as group-V eggs) will be due to mortality and to mixing of water in the intervening period. Catches were made by three vertical hauls of the Helgoland larva-net hauled from the bottom to the surface of the sea, adjustments being made for non-vertical hauls and for the unfiltered water, approximately 4 metres in depth, between the sea bed and the mouth of the net when the haul is commenced.

The observations were made at the end of the spawning period of plaice in the southern North Sea, at a time when as usual, the spawn-

ing area had moved northward and had split up into localised concentrations.

The drift of eggs between cruise 3 (12.—16. February) and cruise 4 (1.—5. March).

Comparing Figures 28 and 29 it is seen that there were on cruise 3 considerable numbers of group-I eggs over a wide area with two main concentrations, one east of Lowestoft and the other off Texel, with a third more diffuse area at the north-western edge of the area surveyed. By 1.—5. March the distribution of these eggs, now stage V, had changed in some parts of the area but not in others. The dense patch of group-V eggs off Lowestoft on cruise 4 could only have come from the group-I eggs in the same area on cruise 3, indicating insignificant residual drift of the water in this area. North of this area a very marked change had occurred. In cruise 4 up to 50 group-V eggs per 100 m.³ were found at the northern extremity of the area surveyed, in an area where less than 20 group-I eggs had been found on cruise 3. Also, on cruise 4, a tongue of water virtually free of group-V

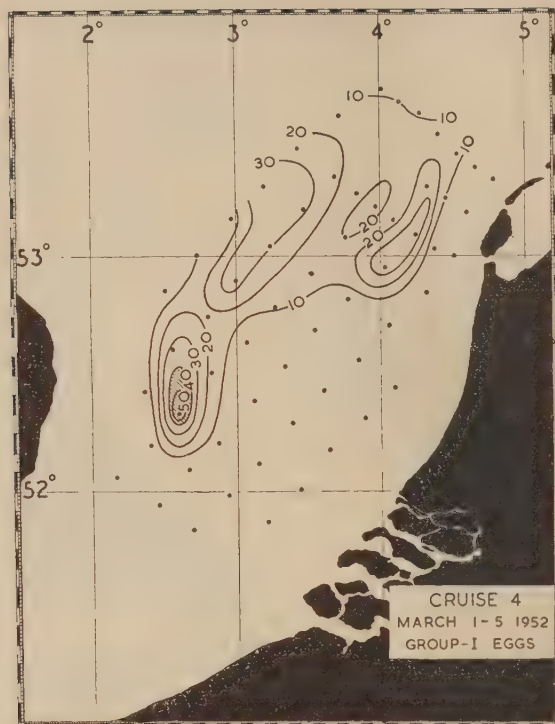


Figure 30.

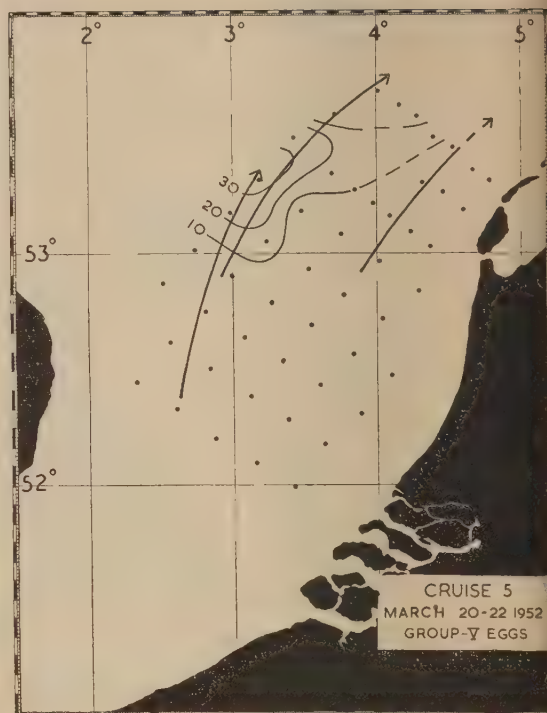


Figure 31.

eggs penetrated the centre of the area from the west, where previously there had been moderate numbers of eggs. These two observations indicate a considerable movement of water to the east-north-east at about 53° to $53\frac{1}{2}^{\circ}$ N. latitude. The probable extent of this easterly water movement is shown by the arrow, indicating a movement of about 60 miles in 17 days.

The interpretation of the changes on the easterly side of the area are less certain, there being no marked concentration to follow. That the numbers of group-I eggs found on cruise 3 south and east of the concentration off Lowestoft had been considerably reduced is definite. Whether they have been reduced by the herring which have been found eating large numbers of plaice eggs in this area or whether Channel water flowing parallel with the Dutch coast, or both, have been responsible for this depletion can not be deduced for certain.

Between 11. and 29. February the winds were predominantly from the west and north-west while, for the first five days of March, immediately before cruise 4, the winds blew

strongly from the south and south-west. It does thus appear that during these 19 days the earlier westerly winds produced a water movement which influenced the northernmost part of the area surveyed, the water west of East Anglia remaining static or moving slightly south only to be returned to nearly the same position by a northerly movement resulting from the later southerly winds.

The very localised concentration of group-V eggs on cruise 4 off Texel may have been derived from the larger concentration which had been found on cruise 3 a little south-west of this position. However, the large movement eastwards just north of this position combined with the possible north-easterly movement off the Dutch coast would suggest that the group-I eggs off Texel on cruise 3 had been drifted north-east beyond the area of survey and that the very localised patch of group-V eggs off Texel is part of the "ridge" of relatively static water lying between the east going water in the north and the north-east going water on the eastern side of the Southern Bight.

The drift of eggs between cruise 4 (1.—5. March) and cruise 5 (20.—22. March).

On cruise 5, 20.—22. March, there was only one area of group-V eggs (Figure 31). These eggs can only have come from the south or west as any other movement would have brought many eggs into the area south of 53°N., where, in fact, not more than 1 group-V egg per 100 m.³ was found at any station. There seems no doubt that these group-V eggs were derived from the concentration of group-I eggs of cruise 4 which were then directly east of Lowestoft. This would give a north-north-easterly drift of these eggs of approximately 63 miles. That this north-north-easterly movement of the eggs was widespread in the Southern Bight at this time is shown by the absence of group-V eggs off Texel, the concentration of group-I eggs off Texel on cruise 4 must have been drifted at least the 40 miles to beyond the north-easterly limit of the cruise 5 survey. Similarly the water containing over 30 group-I

eggs per 100 m.³ lying between 3° E. and 4° E. on cruise 4 appears to have been drifted beyond the area of survey — presumably in the general north-easterly direction—giving another movement of at least 60 miles in 17 days.

No attempt is made in this note to relate these observations to current measurements at lightvessels etc., the aim being to present the biological data and to show that although this method has limitations it can give useful and at times detailed information on the drift of fish eggs and therefore of other planktonic organisms.

A. C. SIMPSON

Haddock.

Scottish Investigations.

During 1952, the haddock population of the North Sea and western grounds has been sampled as in previous years by F. R. S. "Explorer".

Table 11. Age Composition of Haddock caught by F. R. S. "Explorer" in 1952.

Per 10 Hours Trawling.															
Northern Area						North Central Area					Central Area				
Month.	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months
Hours trawling	1	13	2	—	16	3	11	20	6	40	7	55	11	12	85
Year- Class					Weighted Means					Weighted Means					Weighted Means
1951	790	813	915	—	824	6013	2444	7306	2208	5107	187	5903	5640	4627	5218
1950	900	235	145	—	266	367	321	89	220	193	9	266	66	82	193
1949	100	194	130	—	180	170	133	36	95	82	16	91	21	27	66
1948	—	68	100	—	68	43	54	21	40	35	3	16	6	9	13
1947	10	7	15	—	8	—	5	1	5	2	3	1	—	—	1
1946	—	2	5	—	2	—	1	—	—	—	—	—	—	—	—
1945	—	15	100	—	25	7	10	3	—	5	1	—	—	—	—
1944 and over	—	1	10	—	2	—	—	—	—	—	—	—	—	—	—
All ages	1800	1335	1420	—	1375	6600	2968	7456	2568	5424	219	6277	5733	4745	5491

Moray Firth and Orkney						Firth of Forth					Western Area				
Month.	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months	Jan./ Mar.	Apr./ June	July/ Sept.	Oct./ Nov.	All months
Hours trawling	24	16	19	11	70	Not visited					3	30	—	2½	35½
Year- Class					Weighted Means										Weighted Means
1951	191	2924	4571	584	2066	—	—	—	—	—	37	33	—	216	46
1950	47	86	58	14	54	—	—	—	—	—	197	53	—	80	67
1949	35	39	78	3	42	—	—	—	—	—	123	47	—	76	55
1948	14	32	35	2	22	—	—	—	—	—	20	22	—	76	26
1947	2	2	1	—	1	—	—	—	—	—	7	4	—	16	5
1946	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
1945	1	—	—	—	—	—	—	—	—	—	—	16	—	20	15
1944 and over	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
All ages	288	3083	4743	603	2185	—	—	—	—	—	384	177	—	484	216

Age composition.

The age composition of haddock caught by "Explorer" during 1952 is shown in Table 11, expressed as numbers of each brood caught per 10 hours' fishing in different areas, and during different seasons of the year.

The 1945 and 1947 broods, which were quite well represented in catches during 1950, were only poorly represented in 1952. The bulk of the catches was then made up of the 1948, 1949, 1950, and 1951 broods, of which all but the latter were large enough to have contributed to the landings of the commercial fisherman.

The 1949 brood was distributed most densely over the northern area, contrasting with

Table 12.**Distribution and Density of the 1952 Brood in "Explorer" Catches July to November 1952.**

Area	No. of fish	No. of hours	per 10 hrs.
Northern.....	150	2	750
North Central.....	1170	26	450
Central.....	3411	23	1483
Moray Firth.....	15	30	5
Firth of Forth.....	not visited	—	—
Western.....	16	32½	5
Total for all Areas	4762	113½	420

its distribution in 1950, when it was best represented in the north central and central areas. The 1951 brood was distributed most

Table 13. Mean Lengths (cm.) and Standard Errors of Haddock of each Age-Group from the North Sea and Western Grounds—1952.

Year-Class	Age	Month	Northern			North Central			Central			Moray Firth and Orkney			West		
			Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish	Mean	S.E.	No. of Fish
1952	0+	June	—	—	—	—	—	—	—	—	—	—	—	—	6.0	—	3
		July-Sept.	13.2	0.121	150	14.1	0.073	352	14.5	0.112	210	11.8	0.970	5	—	—	—
		Oct.-Nov.	—	—	—	17.0	0.066	818	17.5	0.024	3201	17.8	0.533	10	16.3	0.382	13
1951	0+	Jan.-March	19.2	0.101	79	18.7	0.028	1804	18.6	0.136	131	19.5	0.075	458	19.3	0.195	11
	1+	April-June	17.8	0.046	1057	20.5	0.052	2688	20.9	0.010	32469	21.1	0.030	4678	23.5	0.284	100
	1+	July-Sept.	22.8	0.105	183	25.0	0.014	14613	25.4	0.022	6204	25.6	0.017	8684	—	—	—
	1+	Oct.-Nov.	—	—	—	25.0	0.042	1325	27.0	0.024	5553	27.3	0.077	642	28.4	0.250	54
1950	1+	Jan.-March	25.9	0.225	90	27.5	0.192	110	28.7	0.802	6	29.5	0.278	113	27.9	0.313	59
	2+	April-June	26.2	0.155	306	27.5	0.143	353	28.8	0.049	1461	30.6	0.225	137	30.6	0.171	158
	2+	July-Sept.	28.0	0.338	29	31.8	0.157	178	32.6	0.249	73	35.8	0.310	110	—	—	—
	2+	Oct.-Nov.	—	—	—	29.1	0.202	132	35.7	0.275	99	37.4	0.689	15	34.0	0.669	20
1949	2+	Jan.-March	33.4	0.733	10	35.2	0.440	51	38.2	1.536	11	37.6	0.390	83	33.7	0.395	37
	3+	April-June	31.8	0.170	252	32.6	0.271	147	34.8	0.115	498	38.7	0.356	63	33.8	0.263	141
	3+	July-Sept.	32.8	0.450	26	35.2	0.345	73	36.3	0.559	23	43.2	0.352	148	—	—	—
	3+	Oct.-Nov.	—	—	—	33.2	0.350	57	39.9	0.550	33	41.0	0.577	3	37.5	0.711	19
1948	3+	Jan.-March	—	—	—	37.4	1.041	13	45.0	—	2	42.3	0.857	33	40.3	0.843	6
	4+	April-June	36.2	0.366	89	37.2	0.531	59	38.7	0.296	90	44.2	0.786	52	39.9	0.528	67
	4+	July-Sept.	36.9	0.542	20	38.5	0.610	43	39.7	0.714	7	48.8	0.706	66	—	—	—
	4+	Oct.-Nov.	—	—	—	35.2	0.421	24	45.6	1.208	11	43.0	1.000	2	42.6	0.856	19
1947	4+	Jan.-March	36.0	—	1	—	—	—	42.0	3.000	2	50.8	2.596	5	43.5	0.500	2
	5+	April-June	38.4	1.180	9	36.8	1.463	5	44.3	1.443	7	51.7	0.342	3	43.1	1.138	12
	5+	July-Sept.	40.0	3.000	3	44.0	—	2	—	—	—	64.0	—	1	—	—	—
	5+	Oct.-Nov.	—	—	—	39.3	2.029	3	—	—	—	—	—	—	45.5	1.323	4
1946	5+	Jan.-March	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	6+	April-June	44.0	6.083	3	39.0	—	1	—	—	—	—	—	—	46.5	6.500	2
	6+	July-Sept.	43.0	—	1	—	—	—	—	—	—	—	—	—	—	—	—
	6+	Oct.-Nov.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1945	6+	Jan.-March	—	—	—	43.0	1.000	2	48.0	—	1	53.0	4.000	2	—	—	—
	7+	April-June	43.4	1.085	20	44.6	1.728	11	60.0	—	1	50.0	—	1	45.8	0.757	47
	7+	July-Sept.	43.2	0.920	20	45.7	2.629	6	—	—	—	—	—	—	—	—	—
	7+	Oct.-Nov.	—	—	—	—	—	—	—	—	—	—	—	—	46.4	0.678	5

Firth of Forth — not visited

Table 14. Landings of Haddock by British Trawlers from North Sea Regions in 1952.

	North of Lat. 57°30'N.			Lat. 55°N. to 57°30'N.			South of Lat. 55°00'N.			All Areas ¹⁾		
	Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.	Weight landed/ 100 cwt.	100 hrs. fishing	Weight landed/ 100 hrs.
Jan.-March	592	671	88.2	76	227	33.5	9	1702	0.5	864	2758	31.3
April-June	934	932	100.2	125	509	24.6	18	938	1.9	1256	2572	48.8
July-Sept.	239	603	39.6	515	867	59.4	75	1086	6.9	932	2725	34.2
Oct.-Dec.	359	606	59.2	717	740	76.9	58	1257	4.6	1314	2841	46.3

¹⁾ Includes landings from unknown rectangles.

densely in the central area as was also true of the 1952 brood in these records. The distribution and density of this brood is shown in Table 12. The catch per 10 hours' fishing in the central area of 1483 fish, and the overall mean of 420 fish per 10 hours, distinguish this as a good brood, second only in fact during post-war years, to the very good brood of 1951.

Size composition.

As in previous years, the largest haddock, age for age, were taken from the central area, whereas the smallest came from the deeper waters of the northern area. (See Table 13).

Commercial fishery.

During 1952, there was a decrease in both total catch and in catch per 100 hours by British trawlers fishing south of Lat. 57°30'N., (Table 14) as compared with 1951. North of this latitude, there was little difference

between the total yields obtained during 1951 and 1952.

R. JONES, W. MAIN.

Whiting.**British Statistics.**

The data in Table 15 are presented as a summary of the landings by British steam trawlers in 1952. As in previous years, they are set out in the form adopted for haddock in Volume VI.

A comparison of the data in Table 15 with those published in earlier volumes of this journal shows that, since 1947, the whiting landings per 100 hours' fishing fluctuated seasonally, but no general upward or downward trend is apparent. The landings per unit of effort from the southern and central regions remained at about the same level from 1947 to 1952. In 1949 and 1950 the landings from the northern region were much lower than those in 1947, 1948, 1951, and 1952.

Table 15. Landings of Whiting by British Steam Trawlers from North Sea, 1952.

Quarterly Period	North of Latitude 57°30'N.			Latitude 55°N. to 57°30'N.		
	Wt. landed in 100 cwt.	100 hours fishing	Wt. landed per 100 hours	Wt. landed in 100 cwt.	100 hours fishing	Wt. landed per 100 hrs.
January to March.....	1023	671	152.4	101	227	44.5
April to June.....	870	932	93.3	81	509	15.9
July to September.....	589	603	97.7	234	867	27.0
October to December.....	891	606	147.0	248	740	33.5
Year.....	3373	2812	120.0	664	2343	28.3

Quarterly Period	South of Latitude 55°N.			All Areas ¹⁾		
	Wt. landed in 100 cwt.	100 hours fishing	Wt. landed per 100 hrs.	Wt. landed in 100 cwt.	100 hours fishing	Wt. landed per 100 hrs.
January to March.....	134	1702	7.9	1465	2758	53.1
April to June.....	70	938	7.5	1120	2572	43.5
July to September.....	129	1086	11.9	1052	2725	38.6
October to December.....	93	1257	7.3	1232	2603	47.3
Year.....	426	4983	8.5	4869	10658	45.6

¹⁾ Includes landings from unknown areas.

ROBERT W. ELLIS.

Plaice.

Table 16. Length Distribution of Lowestoft and Grimsby Landings.

Thousands of Fish.

Length Group (cm.)	Lowestoft 1951—52		Grimsby 1951—52		Lowestoft 1952—53		Grimsby 1952—53	
	Nos.	%	Nos.	%	Nos.	%	Nos.	%
20—24.....	146	0.7	39	0.2	51	0.2	1	0.0
25—29.....	10,768	47.5	4,596	24.1	9,709	41.5	2,410	13.6
30—34.....	7,968	35.2	8,057	42.2	9,259	39.6	7,231	40.6
35—39.....	2,386	10.5	3,950	20.7	2,836	12.1	4,691	26.4
40—44.....	823	3.6	1,386	7.2	921	3.9	2,087	11.7
45—49.....	373	1.7	599	3.1	390	1.7	801	4.5
50—54.....	140	0.6	303	1.6	153	0.7	366	2.1
55—59.....	46	0.2	126	0.7	57	0.2	165	0.9
60+.....	10	0	37	0.2	13	0.1	37	0.2
Total.....	22,660		19,093		23,389		17,790	
Wt. landed (000 cwt.)	125.3		145.0		136.0		156.1	
1000 hours fishing	325.6		372.6		305.7		351.4	

English Landings 1951 and 1952.

During 1952 the routine sampling of the plaice landings at Lowestoft and Grimsby was continued. The main features of the landings are shown in Tables 16 and 17. The former shows the total number of fish landed by English North Sea trawlers at each port in each 5-cm. length-group during the biological year 1952—53, with the landings for 1951—52 as a comparison.

As in previous years, these length distributions have been converted into age distributions by means of an age-length key obtained from otolith samples. The age distribution of the Lowestoft samples, expressed as the number of fish caught per 100 hours fishing, with similar figures for the last 3 years as comparison, is shown in Table 17.

The striking feature of the 1952—53 figures is the increase, both in numbers landed, and

predominantly a ground for good-sized fish. These catches, for 1938 and each post-war year are shown in Table 18, together with the catch per 100 hours fishing from G. 4 (Smith's Knoll). For the latter the levelling-off after the 1946 peak has practically ceased, and the density has reached a steady state of about 44 cwt. per 100 hrs. fishing.

J. A. GULLAND.

The Stock of Plaice off Esbjerg and the Danish Plaice Fishery in the North Sea.

The stock of plaice off Esbjerg.

Quantitative fishing was carried out from the research cutter "Jens Væver" in October in the southern Horns Reef area at 23 stations, of which 5 between 5 and 9 m. depth, 6 between 10 and 19 m., 6 between 20 and 29 m., 3 between 30 and 39 m., and 3 between 40 and 44 m. depth. Outside the 40-m. depth curve the stock of plaice was very thin as compared with the stock inside this curve:— 10 plaice per hour against 98 per hour between 30 and 39 m. depth.

In Table 19 the numbers of plaice caught per hour in the 10—39-m. depth-zones are compared with the numbers found in 1930 and 1933 when quantitative fishing was carried out at the same season. The mean numbers in the various 10-m. depth-zones are added

Table 18. Cwt./100 hrs. fishing from Smith's Knoll and Silver Pits.

	1938	1946	1947	1948	1949	1950	1951	1952
G.4	33	79	63.2	61.3	60.3	44.5	43.7	43.9
G.7	25	75	54.4	54.5	41.2	40.9	43.3	51.1

in density, of the medium sized fish, 35—44 cm. long, and 5—7 years old. This increase also occurs in the catch per 100 hrs. fishing, from rectangle G. 7 (Silver Pits), which is

Table 17. Number of Fish of each Age caught by Lowestoft Trawlers per 100 hrs. fishing.

Age	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII+	Total
1949—50.....	59	1,322	3,793	1,135	365	143	124	71	86	63	90	7,251
1950—51.....	39	929	2,320	1,722	389	198	93	95	81	57	94	6,017
1951—52.....	91	559	2,576	2,055	982	261	152	71	57	60	87	6,960
1952—53.....	142	999	1,424	2,828	1,309	519	123	106	61	40	99	7,650

Table 19. Number of Plaice caught per hour with the 50-foot otter-trawl in the southern Horns Reef area in October 1952,
compared with the corresponding numbers for the years 1930 and 1933.

Length-groups, cm.									Age-groups.										
Depth	Year	5-9	10-14	15-19	20-24	25-29	30-34	Total	Depth	Year	0	I	II	III	IV	V	VI	VII	VIII
5-9 m.	1952	54	9	26	6	2	—	97	5-9 m.	1952	57	10	24	4	0.5	1	—	—	—
10-39 m.	1930	4	130	148	62	24	2	370	10-39 m.	1930	2	47	236	61	12	10	—	0.1	0.2
»	1933	5	20	90	222	26	0.4	363	»	1933	5	30	41	49	70	162	5	0.2	—
»	1952	0.5	0.8	24	44	28	4	101	»	1952	—	4	49	26	8	15	0.5	0.2	—
40-44 m.	1952	—	—	—	10	16	4	30	40-44 m.	1952	—	—	8	6	10	6	—	—	—

with due regard to the relative sizes of the depth-zones (the 20-29-m. depth-zone is about 2 times each of the neighbouring ones). It is seen that the total number of plaice has decreased to less than a third of that in 1930 or 1933. Also from 1950 to 1951 a very great decrease in the number of young plaice was found whereas the young-plaice stock in 1950 was more or less of the same density as before the war (cf. Ann. Biol. 8, p. 112).

From Table 19 it appears that the density especially of the smallest size-groups and the youngest age-groups had decreased strongly which is naturally a bad sign for the fishing in the near future. The scarcity of the I-group corresponds to that of the 0-group found in the Danish Waddensea in 1950 (see Å. VEDEL TÅNING in Ann. Biol. 8, p. 111).

The average length of the age-groups has increased very much corresponding to the lesser density of the stock. Naturally the increased growth is partially the reason for the low density because most of the plaice over ca. 27 cm. length wander to the open North Sea. Although changes in the production of food for the plaice may play a great role for the growth-rate of the plaice the density of the stock is beyond doubt also an essential factor.

The Danish plaice fishery.

Density of the stock.

Together with the market investigations at Esbjerg information of the total weight per landing from various cutters was noted. The mean weights in tons, in landings of which the plaice were sorted, were as follows (number of landings in brackets, map of areas in Ann. Biol. 4, p. 101): —

	1950	1951	1952
A3, NN., May.....	—	2.9 (3)	3.1 (5)
C2, NE., Aug.-Oct.....	4.6 (6)	5.2 (10)	6.2 (18)
C2, NV., August.....	4.6 (5)	—	6.0 (4)
Dogger, May.....	—	2.3 (2)	2.3 (8)

The improvement of the commercial value of the stock stated in 1951 (Ann. Biol. 8, p.

112) has continued in 1952 on the grounds east of the Dogger, where the Danish fishermen normally take the greatest toll of the plaice. No doubt a contributory cause of this improvement is in part due to a decline of the fishing intensity for plaice in these regions, because many Danish cutters have taken part in the herring fishery at the Clay Deep and to the north of the White Bank.

The length distribution of the catches has shifted from 1951 to 1952 towards larger lengths (cf. Table 20), no doubt partly on account of the relatively poor younger age-groups, partly on account of a diminished fishing intensity.

Table 20. Length Composition of Plaice over 27 cm. Length in Danish Catches in 1951 and 1952.

Area	A3, N. ¹⁾		C2, NE. ²⁾		Dogger	
	1951	1952	1951	1952	1951	1952
Year	1951	1952	1951	1952	1951	1952
Month	May	May	Sept.-Oct.	Oct.	May	May
Depth, m.	13	14	50	51	33	26
No. of catches	3	4	9	8	2	9
cm.-group						
27-30....	81	66	81	70	50	27
31-34....	19	33	16	26	32	31
35-39....	0.3	0.1	2	3	11	23
40-44....	—	0.04	0.5	0.8	4	13
45-49....	—	0.01	0.1	0.4	2	3
50-54....	—	—	0.02	0.05	0.4	2
55-60....	—	—	0.01	0.04	0.5	1
61-65....	—	—	—	—	0.05	0.3

¹⁾ North of Horns Reef, 55°33'N. Lat.

²⁾ North of 55°N. Lat., east of 5°E. Long., more than 40 m. depth.

The age distribution (cf. Table 21) shows that the 1948 year-class constituted about a fourth or a third of the number of plaice above 27 cm. length caught in C2, NE. (i.e., SE. of the Tail End). The strength of this year-class was below normal in the Horns Reef area (see Ann. Biol. 8, p. 112) but was rich more to the south¹⁾. In the area C2,

¹⁾ A. KOTTHAUS: »Ergebnisse der Schollenuntersuchungen in der Deutschen Bucht im Jahre 1950 etc.« Ber. d. Deutschen Wiss. Komm. f. Meeresf., N. F., XII, 4, 1952.

Table 21. Age Distribution of Plaice over 270 mm. Length (‰) in Danish Catches in 1952.

Area Month Depth, m.	C2, NE. August 46	November 50	Dogger May 22	Year- class
III.....	2	3	—	1949
IV.....	23	30	6	1948
V.....	58	60	49	1947
VI.....	16	6	28	1946
VII.....	1	0.6	10	1945
VIII.....	—	—	1	1944
IX.....	—	—	2	1943
X.....	—	—	2	1942
XI.....	—	—	0.7	1941

NE. rather few specimens of the rich 1946 year-class were caught, while on the Dogger Bank the 1946 and 1947 year-classes constituted the major part of the stock in May 1952.

The mean length of age-groups of plaice in the depth-zone 10—39 m. off the southern Horns Reef area showed in 1933 and 1952 the following values:—

Age-group	II	III	IV	V
1933.....	—	19.9	23.4	—
1952.....	20.2	25.3	27.8	28.1

AAGE J. C. JENSEN.

Young Plaice in the Danish Waddensea.

Investigations upon the occurrence of young plaice in the Danish Waddensea were carried out as usual with the modified Johansen young-fish-trawl. 78 hauls of 15 minutes' duration are available. Sampling was carried out in June, August, and October 1952.

A fairly high number of 0-group plaice was obtained, namely 302 specimens per hour as against an average of 204 per hour for the years 1935—52.

In 1951 the 0-group was extraordinarily sparse (TÅNING, Ann. Biol., 8, p. 111, 1952) and, accordingly, the I-group plaice in 1952 were few in number (61 per hour as against an average of 171 per hour). Unfortunately, no observations from the German Waddensea are yet available. Caution is therefore needed in assuming a bad influence of the 1951 year-class upon the North Sea plaice fishery. Experience has learned that sampling in the Danish Waddensea is not always representative of the southern North Sea stock of young plaice (cf. TÅNING, Ann. Biol., 7, p. 92, 1951). According to verbal information from Dr. L. K. BOEREMA the group is however weak in Dutch waters also.

ERIK URSIN.

Scottish East Coast Inshore Investigations.

The young plaice populations in the Scottish east coast bays extending from the Moray Firth to the Firth of Forth were examined for density, age, and growth by F.R.S. "Kathleen" in April—May and October—December additional surveys, in continuation of a quantitative study of the variations between hauls begun in 1951, were carried out in Aberdeen Bay in February and June. Surveys, in July and September, of inshore Orkney stocks and, in the former month, Dunnet Bay on the north coast of Scotland were also carried out.

The accompanying Table 22 gives the results of the analysis of the April—May material and is comparable with Table 19 in *Annales Biologiques*, Northern North Sea, 8, (1951), p. 113. It will be seen that, although local variation in abundance, age-composition, and growth-rate continued to be characteristic of the area and the range in size and age remained substantially unaltered, significant changes in size-frequency distribution and age composition in the different bays have occurred within the year. The main changes in age structure are the replacement in most cases of a fairly good I-group (1950 year-class) by a weaker one (1951 year-class), and the continuation of the 1949 and 1948 year-classes as strong components in the Moray Firth. Nairn Bay was noteworthy for the high absolute and relative strengths of the now five-year-old 1947 class and some significant residual representation of the still older 1946 spawned fish. (This locality as well as the other Moray Firth Bays is closed to commercial fishing).

In Aberdeen Bay, the originally strong 1948 year-class has suffered the attrition expected in this fast-growing area where fishing by small vessels is permitted and, with poor recruitment in 1949, the population there consisted predominantly of the fairly abundant 1950 year-class. In St. Andrew's Bay the originally strong 1948, the weaker 1947 and the prolific, slow-growing 1946 year-class, which was notable for its high contribution right up to 1951, have all declined as important constituents of the stock, through fishing or offshore movement, with the result that the 1949 brood is now dominant. This group is also the dominant one in Largo Bay and, with the 1948 class, forms the bulk of the stock in the Firth of Forth.

Table 22. Scottish East Coast 4—37 metres. April-May 1952 (F.R.V. "Kathleen").

	Size Composition (by 5-cm. groups) (%)								Age Composition. Numbers per 4 hours fishing.									
	10 cm. and under	11—15	16—20	21—25	25—30	31—35	36—40	41 +	Total caught	I 1951	II 1950	III 1949	IV 1948	V 1947	VI 1946	VII 1945	VIII 1944	Total
Moray Firth																		
Dornoch Firth	2.2	29.5	35.6	25.1	6.5	0.9	0.2	—	1,381	88	459	559	208	64	2	1	—	1,381
Nairn Bay	1.6	6.9	34.4	41.0	12.9	2.7	0.4	—	697	42	202	406	298	422	20	2	2	1,394
Burghead Bay	0.9	11.8	43.6	31.2	11.2	1.3	—	—	321	—	92	304	194	52	—	—	—	642
Spey Bay	0.2	16.0	45.7	27.5	9.9	0.8	—	—	771	—	244	1,004	270	24	—	—	—	1,542
Aberdour Bay	14.7	14.7	39.7	15.4	7.4	3.7	4.4	—	136	50	128	62	22	10	—	—	—	272
Aberdeen Bay	9.0	14.5	60.5	9.6	3.9	1.2	0.3	—	2,183	111	851	82	40	4	4	1	—	1,093
St. Andrew's Bay	2.6	15.6	45.8	32.3	3.5	0.3	—	—	347	14	55	216	46	10	6	—	—	347
Firth of Forth																		
Largo Bay	0.2	18.2	30.8	40.1	9.0	1.5	—	0.2	402	2	98	274	23	3	2	—	—	402
Aberlady Bay	2.8	24.1	33.3	20.6	12.8	5.7	0.7	—	141	20	63	42	15	1	—	—	—	141
	Age Composition (%).								Mean Sizes of Age-Groups (cm.).									
	I	II	III	IV	V	VI	VII	VIII	I	II	III	IV	V	VI	VII	VIII		
Moray Firth																		
Dornoch Firth	6.4	33.2	40.4	15.1	4.6	0.1	0.1	—	10.9	14.7	20.1	23.7	26.5	25.5	30.0	—		
Nairn Bay	3.0	14.5	29.1	21.4	30.3	1.4	0.1	0.1	10.6	16.3	20.0	22.5	25.1	29.9	26.0	28.0		
Burghead Bay	—	14.3	47.4	30.2	8.1	—	—	—	—	13.5	18.9	23.5	27.3	—	—	—		
Spey Bay	—	15.8	65.1	17.5	1.6	—	—	—	—	12.9	19.6	25.6	27.5	—	—	—		
Aberdour Bay	18.4	47.1	22.8	8.1	3.7	—	—	—	9.8	18.1	21.5	30.4	32.4	—	—	—		
Aberdeen Bay	10.2	77.9	7.5	3.7	0.4	0.4	0.1	—	7.9	17.9	24.3	28.8	26.4	32.2	40.0	—		
St. Andrew's Bay	4.0	15.8	62.2	13.3	2.9	1.7	—	—	9.4	13.8	19.8	23.5	23.6	24.8	—	—		
Firth of Forth																		
Largo Bay	0.5	24.4	68.2	5.7	0.7	0.5	—	—	10.0	14.8	21.6	27.2	27.7	39.0	—	—		
Aberlady Bay	14.2	44.7	29.8	10.6	0.7	—	—	—	11.5	17.3	24.4	27.2	27.0	—	—	—		

In the April—May survey, plaice of marketable age (over 25 cm.) as usual formed a small percentage of the total catch, ranging generally from 3.7 % in St. Andrew's Bay to 16.1 %, in Nairn Bay with an exceptionally high percentage (39.7) in Aberlady Bay where the whole population, particularly of the youngest fish, is sparse.

The inshore Orkney grounds and the adjacent Dunnet Bay, which are not given in the table, showed young stocks consisting of the three year-classes 1949 to 1951 only.

Records obtained from the operation of the larger research vessels on offshore grounds indicated little change from the normal, the sparse population consisting of groups III to over X with most fish between III and V.

Commercial landings of plaice in Scotland in 1952 totalled 88,403 cwt. of which 84,655 cwt. came from the North Sea and west of Scotland grounds. This shows a continuation of the steady yield of the species from home waters which has been experienced since 1947, following the fishing out of the war-time accumulation of the stock. As usual the bulk of the catch was obtained from seine netting.

B. B. RAE, J. M. LAMONT.

German Plaice Investigations in 1952.

During 1952 the plaice population of the German Bight has been investigated as in previous years by the research cutter "Uthörn" of the Biologische Anstalt Helgoland (KORTHAUS 1949, 1950, 1952). In this year a new section "Westerland", with three stations (10, 15 and 20 m. depth), was put between the sections "List" and "Amrum", so that to-day the total number of stations amounts to twenty (four in the vicinity of the island Helgoland and sixteen in the north-Frisian coastal waters (10—20 m. depth)) between the estuary of the Elbe in the south and Graadby in the north. Three experimental catches in autumn 1952 carried out on the 40-m. line (stations: "Hever IV", "Westerland IV" and "Horns Reef L.V.") are not included because no comparable material is available from 1948—1952.

As in previous years, hauls of $\frac{1}{2}$ -hour's duration were carried out using the "Kutter trawl" (cod-end with 9 cm. mesh, the so-called "Zungensteert"). So as to make the material comparable with pre-war investigations the catches were treated by the method described by BÜCKMANN (1932) to make them equivalent

Table 23. Age-Composition of Plaice in the German Catches from 1948—1952.

(Converted into catches with a covered cod-end).

Age-Groups:	I	II	III	IV	V	VI+	Total number examined	Number of stations
Spring 1948.....	—	20	54	21	3	2	3,652	15
Autumn 1948.....	11	43	32	11	2	1	2,595	17
Year-class:.....	1947	1946	1945	1944	1943	1942-		
Spring 1949.....	1	6	50	33	8	2	1,482	16
Autumn 1949.....	38	49	9	3	1	+	14,157	17
Year-class:.....	1948	1947	1946	1945	1944	1943-		
Spring 1950.....	—	11	71	15	3	+	10,642	17
Autumn 1950.....	10	21	58	9	2	+	6,011	16
Year-class:.....	1949	1948	1947	1946	1945	1944-		
Spring 1951.....	1	26	24	44	5	1	8,197	17
Autumn 1951.....	33	27	10	27	2	1	7,519	18
Year-class:.....	1950	1949	1948	1947	1946	1945-		
Spring 1952.....	—	30	31	13	22	3	12,249	20
Autumn 1952.....	12	52	16	5	13	1	4,689	20
Year-class:.....	1951	1950	1949	1948	1947	1946-		

to those expected if the cod-end had been covered by a small mesh ("Decknetz").

1. Age composition.

Table 23 shows the relative age composition of the plaice catches. For comparison the corresponding figures of the years 1948 to 1951 are added.

In spring 1952 the 1949 and 1950 broods predominated, each making up nearly one third of the catches. Age-group IV, year-class 1948, only represented 13 % of the total, whilst the rich 1947 year-class, age-group V, was still to be found with the exceptionally high percentage of 22.

In comparison with the autumn of 1951 the age-composition of the stock has not substantially changed.

In autumn 1952 we found a notable recruitment of the plaice stock. Year-class 1950, age-group II, accounted for more than 50 % of the catches, whilst all the other year-classes were insignificant except the rich year-class 1947 which was still present with the exceptionally high proportion of 13 %.

2. Growth.

In spring 1952 the mean lengths of the age-groups were nearly the same as in the previous year (see Table 24). From autumn 1951 to

Table 24. Average Length (cm.) of the Age-Groups in the German Catches from 1948—1952.

(Converted into catches with a covered cod-end).

Age-Groups:	I	II	III	IV	V	VI	Average length of the total catch.
Spring 1948.....	—	19.7	21.1	23.9	26.1	28.2	21.4
Autumn 1948.....	18.5	21.0	23.4	25.8	29.4	30.1	22.0
Year-class:.....	1947	1946	1945	1944	1943	1942	
Spring 1949.....	—	20.0	22.3	23.4	26.5	29.8	23.2
Autumn 1949.....	14.5	17.8	23.0	26.1	28.5	30.8	17.5
Year-class:.....	1948	1947	1946	1945	1944	1943	
Spring 1950.....	—	14.4	17.2	23.6	26.5	28.7	16.8
Autumn 1950.....	16.5	20.9	22.2	25.6	28.3	31.7	21.8
Year-class:.....	1949	1948	1947	1946	1945	1944	
Spring 1951.....	—	16.2	19.3	21.4	24.9	28.5	19.9
Autumn 1951.....	15.6	19.0	22.5	23.9	27.9	31.2	19.8
Year-class:.....	1950	1949	1948	1947	1946	1945	
Spring 1952.....	—	16.2	19.9	22.9	24.1	26.4	20.4
Autumn 1952.....	15.8	18.8	22.9	25.5	26.3	29.3	20.6
Year-class:.....	1951	1950	1949	1948	1947	1946	

Table 25. Catch per Hour of the various Age-Groups in the Years 1948—1952.

Age-Groups:	(Converted into catches with a covered cod-end).						Mean catch per hour
	I	II	III	IV	V	VI+	
Spring 1948.....	2	95	265	102	17	6	487
Autumn 1948.....	33	130	98	34	6	4	306
Year-class:.....	1947	1946	1945	1944	1943	1942-	
Spring 1949.....	2	11	92	60	16	4	185
Autumn 1949.....	599	829	170	54	11	4	1,665
Year-class:.....	1948	1947	1946	1945	1944	1943-	
Spring 1950.....	—	136	883	186	39	6	1,252
Autumn 1950.....	77	165	461	69	17	3	796
Year-class:.....	1949	1948	1947	1946	1945	1944-	
Spring 1951.....	6	248	231	424	45	10	964
Autumn 1951.....	278	228	85	225	14	5	835
Year-class:.....	1950	1949	1948	1947	1946	1945-	
Spring 1952.....	—	361	385	160	274	45	1,225
Autumn 1952.....	58	243	74	25	62	6	469
Year-class:.....	1951	1950	1949	1948	1947	1946-	

spring 1952 growth was slow, as is usual in winter, compared to the fast growth from spring to autumn 1952. Only the mean length of age-group V was less in spring 1952 than in autumn 1951, perhaps because the larger individuals having reached maturity had migrated off-shore, so that only the smaller, still immature, fish remained.

The growth from spring to autumn in 1952 amounted to nearly 3 cm. for the younger year-classes 1950 to 1948, and to 2—3 cm. for the older ones, which is nearly the same rate of growth as in 1951. Nevertheless, the average lengths are less, some considerably less, than the corresponding figures for the year 1948, as shown in the following table:—

Age-group	II	III	IV	V	VI
Spring 1948.....	19.7	21.1	23.9	26.1	28.2 cm.
Spring 1952.....	16.2	19.9	22.9	24.1	26.4 cm.
Autumn 1948.....	21.0	23.4	25.8	29.4	30.1 cm.
Autumn 1952.....	18.8	22.9	25.5	26.3	29.3 cm.

3. Density of stock and relative strength of the year-classes.

In autumn 1951 the catch per hour, the relative measure for density of stock, amounted to 835 fish, but in spring 1952 it increased by about 50 % to 1,225. It declined during the summer to only 469 fish by autumn 1952 when the stocks became extremely poor.

The rise of density from autumn 1951 to spring 1952 is caused by greater catches in all year-classes as shown in Table 25. A satisfactory reason for this fact cannot be given at the moment.

From spring to autumn 1952 all year-classes declined, particularly those of 1949 and 1947. We may assume that the decline chiefly in the older year-classes is caused by the commercial fishery, while the younger ones may have migrated to other places, for they are still too small to be retained by the meshes of the commercial nets.

It is not easy to decide the actual strength of the different year-classes in the plaice stock of the German Bight, but if we calculate the ratio, which every year-class has contributed to the catches per hour during a distinct space of time, we get an approximate measure for it. We have chosen the third and fourth year of life as a suitable time, as the 0- and I-groups are not caught representatively, while the stock of older fish may have been reduced by commercial fishing or may have partly migrated.

If we do this, we may only assess the strength of the year-classes 1946 to 1949.

There were present in the catches per hour:—

Year-class:	1946	1947	1948	1949
as II-group:	221	840	301	476 individuals
as III-group:	262	1343	316	469 »
Totals	483	2183	617	945 »

Assuming year-class 1947 equal to 100, the relative strength of the year-classes is as follows:

Year-class:	1946	1947	1948	1949
	22	100	28	43

Table 26. Percentage Ratio of Plaice more than 25 cm. in the Catches from 1948 to 1952.

(Converted into catches with a covered cod-end).

Age-Groups:	I	II	III	IV	V	VI	VII+	Total of marketable fish, %
Spring 1948.....	0	0	4	33	67	92	100	12.7
Autumn 1948.....	0	4	24	56	89	100	100	18.9
Year-class:.....	1947	1946	1945	1944	1943	1942	1941-	
Spring 1949.....	0	0	12	38	63	82	100	25.8
Autumn 1949.....	0	1	22	64	89	100	100	5.6
Year-class:.....	1948	1947	1946	1945	1944	1943	1942-	
Spring 1950.....	0	1	30	72	94	100	100	7.7
Autumn 1950.....	0	0	4	12	54	95	100	14.6
Year-class:.....	1949	1948	1947	1946	1945	1944	1943-	
Spring 1951.....	0	0	2	10	51	94	100	8.4
Autumn 1951.....	0	1	16	30	87	100	100	12.0
Year-class:.....	1950	1949	1948	1947	1946	1945	1944-	
Spring 1952.....	0	2	20	34	67	96	100	23.4
Autumn 1952.....	0	0	21	57	68	94	100	17.0
Year-class:.....	1951	1950	1949	1948	1947	1946	1945-	

With much caution we may add the year-class 1950 with the index 33. This calculation would be more positive, if we could compare the participation of the different year-classes in the commercial catches, but unfortunately the German market investigations on plaice have not yet been re-introduced after the war.

4. Length distribution.

As shown in Table 26, 13.4 % in the spring of 1952, and 17.0 % in the autumn of the plaice caught had exceeded the minimum size limit for marketable fish (25 cm. in Germany). This is much more than in the two previous years, and is chiefly caused by the rich 1947 year-class, now five years old. Only the seven-year and older fish have reached marketable length throughout their size-range.

Since only 50 % of the 1947 year-class have reached the lower size limit for the market, it is to be hoped that it will be of greater importance still in the commercial catches of the year 1953.

ADOLF KOTTHAUS.

The Abundance of Plaice and Sole of the 0-Group in the Waddensea Area between Weser and Spiekeroog.

Catches with the Johansen young-plaice-trawl were made in our area from 1949 onwards every year during July and during September/October (1949 during August), in the depth zone of 1—3 m., in almost every place where fishing was possible with respect

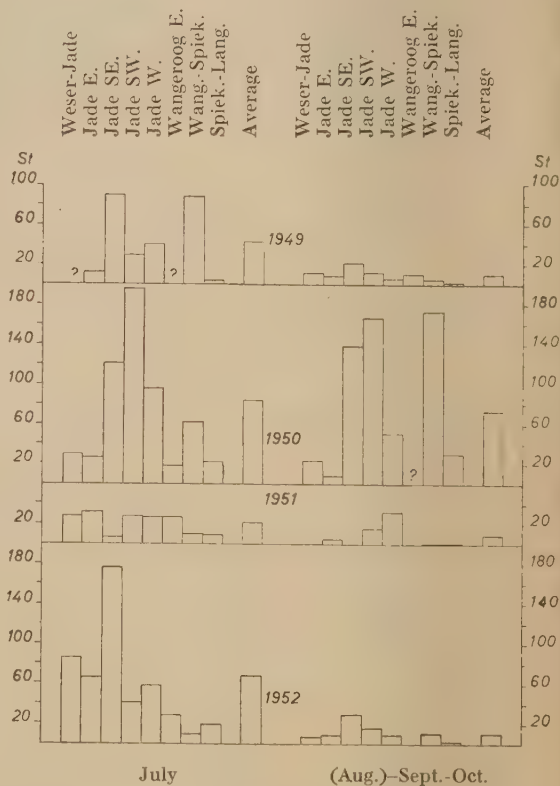


Figure 32. 0-group plaice, catch in 30' with the Johansen net.

of bottom conditions. The total duration of fishing per month varied from 10 to 19 hours, as local changes in depth and in the positions of shrimp nets had to be taken into consideration.

Concerning the reliability of the averages calculated from such catches under the very variable local conditions of the German Waddensea cf. BÜCKMANN 1934, Ber. Dtsch. wiss. Komm. Meeresforsch., N. F., 7, 3, pp. 320—27.

The area now investigated is not particularly rich in small plaice, and is by far inferior in this respect to the area between the Weser estuary and the peninsula of Eiderstedt.

Figure 32 represents the catch of 0-group plaice per 30 minutes haul in different parts of the area, in order to show the amount of variation observed. — It may be taken as significant that the catch of the rich 1950 year-class did not by far decrease at the same rate from July towards September as did the other year-classes. The following averages are calculated for the whole of the area investigated:—

	Plaice					
	Number in 30 min.			Average length, mm.		
	VII	VIII	IX/X	VII	VIII	IX/X
1949.....	43	10	—	48	57	—
1950.....	84	—	72	53	—	60
1951.....	22	—	9	58	—	76
1952.....	68	—	11	47	—	63

	Sole					
	Number in 30 min.			Average length, mm.		
	VII	VIII	IX/X	VII	VIII	IX/X
1949.....	1.2	3.3	—	38	57	—
1950.....	5.1	—	18.3	47	—	70
1951.....	0.0	—	0.6	34	—	71
1952.....	0.2	—	0.6	37	—	68

A. BÜCKMANN.

Dab.

The Stock in the Southern Horns Reef Area.

The density of the stock of dab in the southern Horns Reef area was less than in the 30's (see Table 27) as was also the density in 1950 and 1951 (cp. Ann. Biol. 8, p. 114).

AAGE J. C. JENSEN.

Table 27. Numbers of Dab caught per Hour in the Southern Horns Reef Area in October 1952.
compared with means for the years 1930 and 1933 in the same month.

		Length-groups, cm.							Age-groups							
		2-9	10-14	15-19	20-24	25-29	31-34	Total			0	I	II	III	IV	V
5-9 m. . .	1952	182	41	11	5	0.4	—	239	5-9 m. . . .	1952	—	174	47	15	2	—
10-39 m. .	1930	605	366	147	32	0.8	—	1151	10-39 m. . .	»	0.1	32	108	48	7	1
»	1933	110	499	294	34	1	0.2	914	40-44 m. . .	»	—	105	162	14	1	—
»	1952	4	59	99	32	4	—	198								
40-44 m. .	1952	7	173	92	9	1	—	282								

Mackerel.

Tagging Experiments on Mackerel in Norwegian Waters.

The tagging experiments begun in 1951 (see *Annales Biologiques* 8, p. 114) have produced further recoveries of tagged fish in 1952. The chart in Figure 33 shows the total recoveries to date.

GUNNAR DANNEVIG.

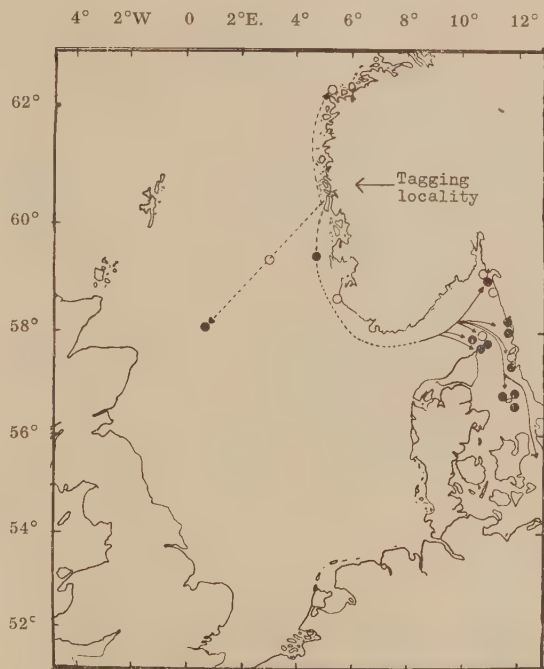


Figure 33. Tagging experiments on mackerel 1951.

● Fish recaptured in 1951.
○ Fish recaptured in 1952.

Rare Fishes.

Occurrences of rare and exotic fishes recorded in Scotland during 1952 appear to reflect very different conditions from those pertaining during the previous year.

Outstanding features of the 1952 records are:—

1. The large numbers of Ray's bream in the northern North Sea and the relatively short period of the "invasion" — mid-October to mid-December.
2. The presence in coastal waters off the east coast of such forms as red mullet (in greater numbers than usual), sting ray and eagle ray and the possibility that these species reached the Scottish area from the southern North Sea.
3. The occurrence of a few northern deep water forms such as the jelly cat (*Anarhichas latifrons*), blue ling, deal fish and ribbon fish.
4. The appearance during the summer months west and north of Scotland (south Minch to Shetland) of sunfish and of opah with no evidence of penetration into the North Sea.
5. The evidence obtained of the presence in numbers of the six-gilled shark in the north-western approaches and, subsequently, the recording of a specimen within the North Sea.

The following is a list of the principal species. Occurrences in Icelandic and Faroese waters have been included in the North-Western Area report.

Hexanchus griseus (GMELIN)—six-gilled shark—at least 13 NW. of Sule Skerry, VII; 1 SE. of Fair Isle, XI.

Lamna cornubica (GMELIN)—porbeagle—2 N. Sea, V, IX; 1 W. coast, XI.

Trygon pastinaca (L.)—sting ray—2 N. Sea, XI.

Myliobatis aquila (L.)—eagle ray—2 N. Sea, XI.

Chimaera monstrosa L.—rabbit fish—1 NE. by E. from Shetland, IV, 1 NW. from Sule Skerry, VII.

Acipenser sturio L.—sturgeon—2 N. Sea, I, V; 1 NW. coast, II.

Alosa alosa (L.)—allis shad—3 Firth of Clyde area, III, XI, XI; 1 Outer Hebrides, VII; 1 in river Tweed, VIII.

Alosa finta (CUVIER)—twaithe shad—1 Shetland, II.

Sardina pilchardus (WALBAUM)—pilchard—5 Minch, I, II; small numbers in herring catches off S. Uist, X, XI.

Belone belone (L.)—garfish—10 N. Sea, IV (8), VII, VIII.

Molva byrkelange (WALBAUM)—blue ling—2 N. Sea, II, IV.

Raniceps raninus (L.)—lesser fork-beard—1 Sea, III.

Lampris luna (GMELIN)—opah or moon-fish—1 Shetland, VIII.

Trachypterus arcticus (BRÜNNICH)—dealfish—1 Shetland, XI.

Regalecus glesne (ASCANIUS)—ribbon-fish or oar fish—1 Firth of Forth, VI.

Capros aper (L.)—boarfish—1 W. coast (55° 48' N. 9° 05' W.), VI.

Brama raii (BLOCH)—34 N. Sea, X (9), XI (21), XII (4).

Mullus surmuletus L.—red mullet—17, 1 Loch Fyne, I; 2 Shetland, II, VIII; 14 North Sea (all south of latitude 58° N.), VIII, X, XI, XII.

Spondyliosoma cantharus (GMELIN)—black bream or old wife—1 N. Sea, XII.

Labrus mixtus L.—cuckoo wrasse—2 N. Sea, VIII; 3 Outer Hebrides, XI.

Trachinus draco L.—greater weever—1 N. Sea, VIII.

Thunnus thynnus (L.)—tunny—4 Fladen Ground, VIII.

Anarhichas latifrons STEENSTRUP and HALLGRIMSSON—jelly cat—1 Viking Bank, VI.

Fierasfer dentatus CUVIER—pearl-fish—2 E. of Shetland, VIII.

Mugil chelo CUVIER—thick-lipped grey mullet—1 Loch Broom, west coast, VII.

Mola mola (L.)—sunfish—1 S. Minch, VI; 4 W. Shetland, Rockall Bank, Sule Skerry Dunnet Bay, VII.

B. B. RAE, E. WILSON.

Report on Food Investigations made with "incidentally" caught Fish Species.

In connexion with the investigations made in the Elbe, and particularly the estuary, the Cuxhaven laboratory of the Institute of Inshore and Inland Fisheries was specially concerned with those species forming the "incidental" catches. Consideration was first directed to those species which are usually incidental to the catches of the shrimp — and "Hamen" — fishermen on the lower Elbe.

The following species were examined: *Cottus scorpius*, *Agonus cataphractus*, *Gobius minutus*, *Centronotus gunellus*, *Osmerus eperlanus*, *Zoarces viviparus*, *Liparis vulgaris*, and *Onos mustela*, and even young *Cyclopterus lumpus*,

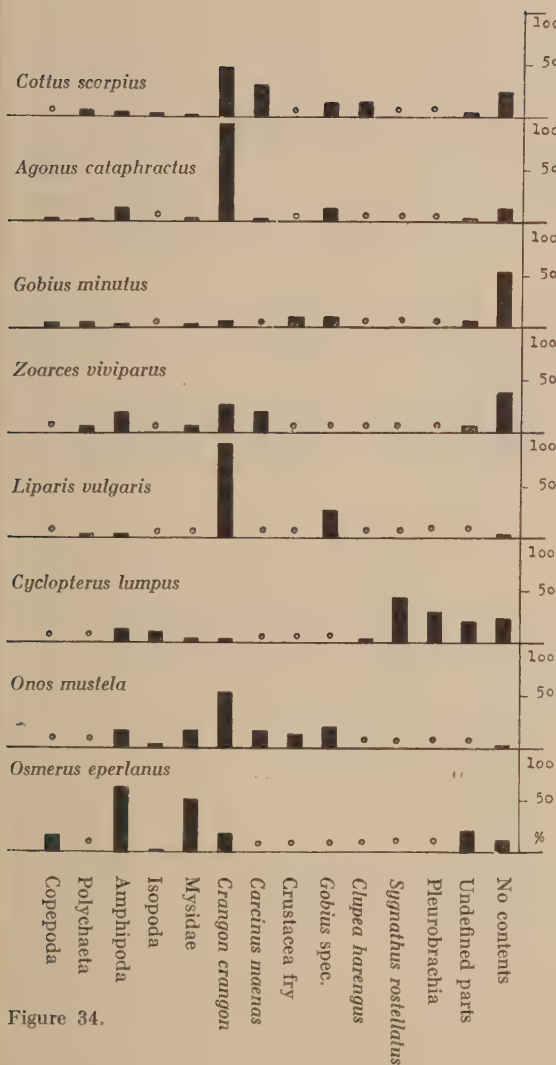


Figure 34.

which regularly appear in the Elbe estuary during the winter months. The results are shown in the diagram above (Fig. 34) (with the exception of *Centronotus gunellus* of which too little material was available). It can clearly be understood from that table that *Crangon crangon* takes the first place among the food fish, followed by the amphipods (gammarids, Corophium), and young *Carcinus maenas*. Fry from *Carcinus*, *Crangon* and *Eriocheir* were particularly evident in the stomachs of *Onos* and *Gobius*. In addition, *Cottus* had been eating *Gobius* and young herring. The amount of *Crangon* found in the stomachs of some fishes

may at times be very considerable. *Cottus* and *Liparis* must specially be mentioned. Twenty *Liparis*, for instance, had on the average more than thirty-five *Crangon* of 1 to 4 cm. in length in their stomachs. Thus these fishes are of a rather considerable ecological importance for the shrimp stocks. The investigations are being continued.

P. MEYER-WAARDEN.

Food of Plaice.

Investigations of the food of plaice have been made in the eastern part of the Helgoland Bight on voyages during spring and autumn since May 1950. With the exception of the spring voyage in 1950 (during which, as far as possible, five plaice of each size group¹⁾ were examined from each station), the length and weight of every plaice examined for gut contents was ascertained on each voyage, together with the names and numbers of all food animals found in the digestive tract, whilst the contents of the guts were measured by the method of volume displacement.

From the spring of 1950 until the autumn of 1952, 1234 plaice were examined in this way (see table below).

		Number of guts	Av. length cm.	Range cm.	Av. volume of stomach and intestine combined cm. ³
1950	spring	114	see ¹⁾		1.690
	autumn	226	22.6	11-41	1.650
1951	spring	132	21.5	12-46	1.970
	autumn	211	21.5	10-34	1.685
1952	spring	253	22.1	13-41	1.590
	autumn	298	23.4	13-46	1.330

The size distribution of the combined stomach and intestine contents in this table is very similar to the average "biomass" (Lebensbestand) of the macrobenthos; there is also a maximum for the spring of 1951. Very few of the guts were completely empty (less than 10 %) and there were no significant differences in volume between the different years and seasons.

During the spring the guts were nearly filled with lamellibranchs, and in the autumn,

¹⁾ Size group	I: 10-15 cm.	=	5 specimens
»	» II: 16-20 »	=	40 »
»	» III: 21-25 »	=	28 »
»	» IV: 26-30 »	=	34 »
»	» V: >30 »	=	7 »
Total		=	114 specimens

Table 28.

	1949	1950		1951		1952	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
Number of samples.....	13	16	33	36	37	42	48
Number of stations.....	13	14	17	19	19	21	24
Range of raw weights (g.).....	{ 0.775— 28.000	0.830— 10.960	0.410— 32.230	1.220— 75.210	0.490— 36.360	0.420— 18.760	0.690— 19.690
Average biomass (in cm. ³) of all samples.	5.816	3.021	7.083	7.528	4.572	3.063	4.639
For comparison, the average biomass values (cm. ³ per 0.1 m. ²) of ten stations examined regularly from the autumn of 1949 to the autumn of 1952, are							
	6.626	2.704	6.953	8.834	3.894	3.321	5.140

mainly with polychaetes and crustacea. Of the bulk of the food eaten by the plaice, *Angulus fabula* is by far the chief, especially in the areas near the coast. Very frequently, the contents in spring consist only of this species: less frequently found are *Nucula*, *Spisula*, and *Abra* spp. as well as *Phaxas pellucidus* and *Angulus tenuis*.

The thick-shelled *Aloidis gibba* seems to be neglected by the plaice, if they have as alternatives plenty of *Abra nitida*, *Abra alba*, and *Phaxas pellucidus*. However, if the thin-shelled lamellibranchs are not available, or if they are too few, the plaice eat *Aloidis* as well²⁾.

Gastropods are of secondary importance as food animals, only *Hydrobia ulvae* being of importance on a few occasions in a limited area off the mouth of the River Elbe.

The chief polychaetes consumed by the plaice are *Nephtys* spp. (especially *Nephtys hombergi*), *Pectinaria*, and *Lanice conchilega*. The chief item of crustacean food consists of amphipods, with *Ampelisca brevicornis* and *Bathyporeia* (mainly *Bathyporeia guilliamsoniana*) dominant whilst there were smaller numbers of the Cumacea, chiefly *Diastylis rathkei* and *Diastylis bradyi*. *Echinocardium cordatum* is eaten in varying amounts over the

whole area, whilst on the coarse-grained sand areas, the guts are often filled with *Echinocardium pusillus*.

Comparison of the gut contents with the biomass of the animals on the bottom shows that the plaice by no means eat all species but are selective.

E. ZIEGELMEIER.

Quantitative Investigations of the Bottom Fauna (Macrobenthos) in the Helgoland Bight.

Bottom investigations were resumed by the Biological Institution in Helgoland in the autumn of 1949. The van Veen bottom sampler (0.10 m.²) is being used. Over the areas off the north Frisian coast, the region off the mouth of the River Elbe, and around Helgoland, from 13—24 stations were regularly examined at fixed times in the spring and autumn of each year (see station chart, Figure 35). In addition, quantitative grab samples were occasionally taken from places further to the west and off the east Frisian coast.

Analyses of the catches in the regularly investigated area, from autumn 1949 until autumn 1952, showed an increase in the bottom fauna following its decrease as the result of the hard winter of 1946—47, up to a maximum in autumn 1950 and spring 1951. This is shown in Table 28 giving the biomass by volume¹⁾ (cm.³ per 0.1 m.² excluding *Echinocardium cordatum*).

The comparatively high value for the autumn of 1949 was due to the dense population of *Abra alba* on the two most northerly stations, where the Esbjerg—England navigation route passes through the area investigated.

The remaining stations yielded an average of 3.310 cm.³ per 0.1 m.².

¹⁾ Volumes of the preserved bottom animals per 0.1 m.² were measured by water displacement in a narrow cylinder permitting measurement to 0.1 cm.³.

²⁾ As could be deduced from the grab sampling, the biomass of those lamellibranchs most valuable to the plaice (mainly *Abra nitida*) had decreased to such a large extent following the maximum development of *Aloidis* in its principal area during the autumn of 1950 that they had nearly disappeared during the spring and autumn of 1951. This decrease was probably caused by competition for food, overcrowding, and particularly by the fact that the sea bed here was covered by animal and plant remains entangled by the *Aloidis* byssus threads in which, among other things, numerous fresh *Abra* shells were found.

Therefore, the number of guts more or less filled with *Aloidis* during the autumn of 1951 was comparatively large. In association, it should be mentioned that the number of plaice per half-hour's haul in the centre of the *Aloidis* region decreased between the autumn of 1950 and the autumn of 1951 from 3171 to 592 specimens.

The bulk of the biomass (Lebensbestand) consists of lamellibranchs — the prime plaice food in the coastal areas being the thin-shelled *Angulus fabula* — and polychaetes, of which *Nephtys hombergi*, *Scoloplos armiger*, *Pectinaria koreni*, and *Lanice conchilega* occurred regularly over most of the area. In the rather deeper water, *Angulus fabula* was found only as single specimens and was replaced by *Nucula nitida*, *Abra alba*, *Abra nitida*, *Venus ovata*, and *Aloidis gibba*.

Of interest is the continuing decrease in the population of *Aloidis gibba* over an extensive part of the central area some seven miles to the north-west of Helgoland. Its maximum development occurred in the autumn of 1950²⁾. The species of echinoderm most commonly found was *Echinocardium cordatum*.

A steady increase was found in the remainder of the macrobenthos. Thus, for example, *Venus gallina*, *Callianassa*, and *Upogebia* have occurred in small numbers from the autumn of 1950 onwards. With the exception of *Amphiura filiformis*, a species frequently caught with the bottom sampler near Helgoland before the cold winter of 1946—47, and which has not yet been found again, most of the species to be expected according to previous sampling are now to be found again.

E. ZIEGELMEIER.

²⁾ At this time, the great increase of *Aloidis gibba*, in relation to the comparatively large number of plaice on the fishing grounds near Helgoland, led to the remarkable development of "cord rings", the origin of which was demonstrated during the food investigations (Fischereiwelt 1951, Heft 3, pp. 52—53).



Figure 35. Bottom sampler stations at the research cruises on board the research cutter "Uthörn" in the years 1949–1952 in the German Bight.

- = Fixed stations
- = Continuously investigated stations.
- + = Occasionally investigated stations

Transition Area.

INTRODUCTION

Contributions have been received from A. DANNEVIG, A. J. C. JENSEN, I. BOHUS JENSEN, N. JERLOV, J. B. KIRKEGAARD, J. KNUDSEN, R. KÄNDLER and H. THOMSEN.

A. Environment.

Hydrography. Prevailing south-westerly and westerly winds in January—February, May—June and September 1952 restrained the outflow from the Baltic and caused high salinities, especially in the southern parts of the area in the same months. Persistent north-easterly winds during October—November intensified the outflow from the Baltic and caused low surface salinities at the end of the year.

A reduced outflow at the surface gives rise shortly afterwards to a correspondingly diminished inflow in the lower water layer. This explains the low salinity at the northern entrance to the Sound (at Svinbådan) in February and June—September and at Halsskov Rev in February and September—October.

At the Fladen and the Svinbådan lightvessels the temperature at the bottom was very high during July—September, which corresponds to an inflow less than normal from the North Sea; but JERLOV points out, that it must also be due to strong vertical mixing caused by strong winds. The mean velocity was 3.8, half Beauforts, against the normal 3.0 in July (according to the monthly reports of the Danish Meteorological Institute); in the other summer months it was practically normal.

The surface temperature was, as a whole, higher than normal in January—February and in May but below normal in the other months.

Benthic Food. Quantitative bottom samples showed that in the Limfjord (Nissum and Livø Broads) the weight of 1st-class plaice food was very little above normal. In Nissum Broad the stock of flatfish (mainly plaice) is much more dense than in Livø Broad, and the amount of 1st-class plaice food is correspondingly less. J. KNUDSEN draws attention to the fact that the immense quantities of *Ascidella*, which have been a serious nuisance to the fishery, were declining.

In Isefjord and the southern Belts the amount of 1st-class plaice food was more or

less the same as in 1951; in Isefjord it was about double the mean of that for Livø Broad. In Isefjord the density of the stock of flatfish is moderate, and here the qualities of the plaice and flounder have been extremely good, corresponding with the good food conditions.

B. Fish.

Eggs and Larvae. The number of cod larvae found per unit time was greater than in 1951, especially in the Belts where it was in May 5 times the mean for 1923—39. This corresponds with the high surface temperature and bottom salinities in April—May. Many whiting larvae were found in the southern Kattegat in June corresponding with the strong inflow. In April, the number of plaice larvae in the central Kattegat and the Belts was very much above normal, giving rise to the great number of 0-group plaice found on the coasts in the summer. The number of flounder larvae was still higher.

Cod. On the Norwegian Skagerak coast the density of the stock of 0-group cod was higher than the mean for 1930—49 but below the mean for 1917—29. The number found in 1950 and 1951 was very low, as also were the densities of the 0-group in each of the last three years in the Oslofjord, especially in its inner parts. On the other hand, the number of older cod caught per trap at Flødevigen were, at least, as great as the mean for 1921—49. Obviously the stock of older cod is also recruited from other regions.

In the Kattegat and the Belts the number of 0-group cod found in summer and autumn was considerably less than that which might be expected from the large number of larvae. The II-group and older were very scarce, and KNUDSEN points out that this is no doubt due to a too heavy fishery of small-sized cod for the fillet factories.

Whiting. On the Norwegian Skagerak coast and in the outer Oslofjord the 0-group was as abundant, as it was during 1940—49, and higher than in the 30. In the northern and central Kattegat the density of the stock, which mainly consisted of the 0- and I-groups, was greater than in 1951 but definitely less than

the mean for 1927—39. In the Belts and the western Baltic it was also greater than the mean for the pre-war years.

Pollock. The density of the 0-group on the Norwegian Skagerak coast and in the outer Oslofjord has shown similar variations from year to year as those found for the cod.

Haddock. Comparatively many 0-group haddock were found inside the Skaw, where they are scarce in most years. They seem to have been carried into these waters by inflows during the summer, since firstly they were not found as larvae in the ring-trawl during the spring, and, secondly because they did not occur in the trawl in the southern Kattegat or the Belts until September, when a strong inflow of saline water took place. The growth was fast.

Plaice. The 1952 year-class was rich in the southern Kattegat and the Belt Sea, corresponding with the high temperature during the first months of the year. The 0-group was found during the autumn in up to 20 m. depth, as has also been the case in some previous years. The stock of older fish caught in the trawl was below the mean for 1927—39, and this was also found for some year-classes, which had started above normal strength. Obviously the fishing intensity is now greater than before the war and has not been diminished to any extent by the fishery for fish for processing, such as had been hoped for.

In the Limfjord the total number caught per hour was below normal, but the 0-group was in the autumn more numerous than normal. The 1950 year-class had about twice the normal density in June 1951, about $1\frac{1}{2}$ the normal density in September 1951 (see Ann. Biol. VIII, p. 123), about $1\frac{1}{4}$ times the normal density in June 1952, but was only $\frac{3}{4}$ of the normal in September 1952. Thus the depletion of the stock has been very much greater than previously.

Quantitative fishing before the transplantation showed the stock of plaice to be at only a third of the density of that found in June, and KIRKEGAARD concludes that the stock in the Nissum Broad is not affected by the fishing of plaice for transplantation.

The transplantation in the Limfjord was carried out as usual. But, because the marking experiments had shown that transportation in vessels from the Limfjord has, in many years, resulted in too great a mortality, the plaice were mostly taken overland from Esbjerg to the Belt Sea.

The temperature at the end of the transportation to the Belt Sea was so high that many of the plaice died, and the rate of recapture therefore became low.

Flounder. The density of the 0-group was below the mean on the southern Swedish Kattegat coast; in the other waters quantitative fishing on the coasts gives only a poor representation of the amount of this species.

In the Limfjord the density of the stock was, as a whole, below normal, as was also the case in the previous years.

Turbot. In the Limfjord the stock was more scarce than normally.

Dab. The density of the stock in the Limfjord, the Kattegat and the Belt Sea was below normal. The trawl catches, which give about 3 times the number of the eel-tog, indicate that the density in the Kattegat was about half and in the Belts about a third of that found in the 30'es.

Fish for Processing were caught in still greater quantities than in 1951. In the Skagerak the increase was 40%, in the Belts 20% and in the Limfjord 50%, whereas in the other regions it had been practically unaltered. In the Skagerak and the northern Kattegat the percentage of whiting had increased enormously, from 10 to 35% in the small-meshed trawls, and in the southern area from 11 to 27%. Undersized haddock were found in the catches in the northern area in great quantities in some of the landings investigated although most of the fish below the minimum size limits are sorted from the catch before landing,—or from almost all of the catches. This shows that the haddock has been far more abundant than normally, which was also found from the quantitative fishing.

Rearing of plaice at Flødevigen and at Lysekil continued to be successful. The herring reared in 1951 at Flødevigen lived in an aquarium until late in the summer of 1952. DANNEVIG also reports on lobster rearing experiments.

Shellfish. The experiments on growing oysters in a pond at Flødevigen have given promising results.

The catch of lobster per gear on the coast west of Arendal has shown no special trend in the years since 1928, but to the east of Arendal the catch in 1952 had declined to about two thirds of the mean for 1940—51 and was about the same or a little less than the mean for 1928—39.

ENVIRONMENT

Hydrography.

1. The Norwegian Skagerak Coast.

The sea temperature is recorded at a depth of one metre at Flødevigen, near Arendal. The decadic means from 1919 to 1949 indicate that

the sea water in winter is getting colder. For the rest of the year the means are rising.

In 1952 the sea temperature was very high in January, February and May. For the rest of the year the sea temperature was relatively low.

Average	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1919—29..	3.06	1.60	2.33	4.63	8.80	12.28	15.52	15.63	13.94	10.84	7.14	4.70
1930—39..	3.41	2.73	2.34	4.79	9.39	13.34	16.61	17.37	14.95	11.45	8.09	5.22
1940—49..	2.69	1.67	1.87	4.36	9.46	13.38	16.84	16.99	15.04	11.73	8.11	5.86
1950.....	3.6	2.2	3.2	5.8	10.8	13.0	16.1	17.5	15.1	12.2	7.6	4.6
1951.....	1.3	1.1	1.0	3.6	8.8	13.5	15.0	16.1	15.1	12.6	8.5	7.4
1952.....	5.2	3.1	2.1	4.5	9.8	11.2	14.6	15.9	13.6	9.6	6.0	4.2

A. DANNEVIG.

2. Swedish Waters.

The hydrographic observations at the Swedish lightships "Vinga" (57°34'N., 11°36'E.),

"Fladen" (57°13'N., 11°51.5'E.), and "Svinbådan" (56°10'N., 12°31'E.) may be taken as representative of the eastern areas of the Kattegat.

Table 1. Monthly Means of Salinity and Temperature in 1952 at Surface and Bottom for the Swedish Lightships "Vinga", "Fladen", and "Svinbådan", and Deviations from Normal Values (Mean Values 1923—52).

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity	Surface											
"Vinga".....	26.15	24.61	23.76	21.27	21.25	23.82	24.81	21.95	23.78	23.86	20.20	23.48
Deviation...	+1.1	-0.1	+0.5	-1.2	+1.9	+3.2	+2.9	+0.5	+0.8	-1.5	-5.0	-1.1
"Fladen"....	23.72	24.28	22.42	20.60	19.35	23.11	22.48	19.37	24.04	22.29	20.12	22.02
Deviation...	-0.4	+0.8	+0.9	-0.3	+0.8	+3.5	+1.9	-0.7	+2.6	-1.2	-3.2	-1.8
"Svinbådan"	17.71	15.92	13.30	13.29	13.57	16.19	13.72	12.93	15.76	13.55	13.29	13.50
Deviation...	+1.7	+0.3	-0.5	-0.2	+1.8	+2.6	+0.5	0.0	+1.8	-1.9	-2.2	-2.2
	Bottom											
"Vinga".....	33.10	34.09	34.22	34.65	34.48	33.47	33.66	33.74	33.48	34.14	34.51	34.19
Deviation...	-0.6	+0.3	-0.1	+0.5	+0.1	-0.6	-0.1	+0.1	-0.4	+0.6	+0.5	+0.4
"Fladen"....	32.21	33.63	33.80	34.42	34.38	33.92	33.38	33.19	33.06	33.74	34.64	33.99
Deviation...	-1.2	+0.2	-0.1	+0.3	+2.0	-0.1	-0.1	0.0	-0.3	+0.4	+1.1	+0.5
"Svinbådan"	29.02	25.32	29.84	32.43	32.83	27.32	23.57	26.37	24.36	28.53	32.14	32.94
Deviation...	-1.4	-4.6	-0.8	+0.8	+0.7	-4.0	-6.2	-3.3	-5.0	-0.7	+1.9	+3.2
Temperature	Surface											
"Vinga".....	3.7	1.7	1.7	4.7	10.3	12.8	16.1	16.7	13.6	9.4	5.7	3.4
Deviation...	+1.0	+0.1	-0.2	-0.2	+0.1	-1.8	-1.3	-1.3	-1.8	-2.0	-2.0	-1.3
"Fladen"....	3.5	1.7	1.7	5.2	10.9	12.8	17.1	16.9	13.6	8.8	5.9	3.4
Deviation...	+1.0	+0.1	-0.2	+0.2	+0.9	-1.2	-0.1	-0.8	-1.7	-2.4	-1.6	-1.1
"Svinbådan"	3.6	1.7	1.9	5.4	10.6	13.2	16.2	16.7	13.6	9.5	6.2	2.9
Deviation...	+1.2	+0.2	-0.1	+1.0	+1.3	-0.6	-0.6	-0.6	-1.3	-1.5	-1.3	-1.3
	Bottom											
"Vinga".....	6.1	4.5	4.7	4.9	5.3	7.4	9.9	11.3	12.9	10.7	8.8	7.5
Deviation...	0.0	-0.6	-0.7	-0.1	-0.2	+0.4	+0.6	+0.1	+0.9	-1.1	-0.7	-0.4
"Fladen"....	5.8	4.6	4.0	4.8	5.7	7.8	11.1	13.3	14.0	11.3	8.3	8.2
Deviation...	-0.6	-0.4	-1.0	-0.2	+0.4	+1.5	+3.2	+3.4	+2.1	-0.8	-2.0	-0.1
"Svinbådan"	4.6	2.6	4.2	4.6	5.5	9.3	14.0	13.4	13.7	11.7	11.5	8.9
Deviation...	-2.0	-2.3	-0.5	-0.5	-0.4	+2.3	+4.6	+2.4	+1.7	+0.2	+0.8	+0.4

Table 2. Monthly Means of Salinity and Temperature at Surface and Bottom at the Lightvessels "Anholt Nord" (A) and "Halsskov Rev" (H) for a Series of Years, and Deviations from these Means in 1952.

(From the Danish Meteorological Institute, Nautical Department)

Month:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Salinity												
Surface												
A Mean . . .	23.5	23.1	20.2	19.2	18.1	18.9	19.4	20.1	20.7	20.7	21.9	22.8
H Mean . . .	16.8	14.8	13.4	13.9	13.0	14.3	13.9	14.4	14.6	16.2	16.3	15.6
A 1952 . . .	5.2	1.6	1.8	0.3	0.7	4.8	2.2	-0.7	1.8	0.9	-2.6	-2.1
H 1952 . . .	3.4	3.1	0.4	-0.1	0.6	—	0.0	-1.1	3.1	-1.1	-2.1	0.0
Bottom												
A Mean . . .	31.8	32.0	32.5	33.0	33.1	32.8	32.3	31.9	31.8	32.2	32.4	32.1
H Mean . . .	21.9	21.7	24.5	27.6	29.7	30.3	29.4	27.6	24.7	23.3	21.5	22.1
A 1952 . . .	-0.1	0.9	0.7	1.0	0.8	0.1	0.0	0.5	0.7	0.9	1.4	1.5
H 1952 . . .	1.6	-0.1	-3.7	2.9	1.8	—	-0.6	0.9	-1.5	-4.9	2.7	4.4
Temperature												
Surface												
A Mean . . .	2.2	1.4	1.9	4.5	9.4	14.2	16.8	16.7	14.5	10.9	7.1	4.1
H Mean . . .	2.4	2.0	2.4	4.5	8.9	12.7	15.7	16.4	14.5	11.1	7.3	4.0
A 1952 . . .	2.1	0.7	0.3	0.4	1.4	-1.4	-0.3	0.2	-0.7	-1.3	-0.9	-0.5
H 1952 . . .	1.0	-0.5	-0.4	1.0	1.6	—	0.1	-0.1	-0.9	-1.2	-0.8	-0.8
Bottom												
A Mean . . .	6.1	4.7	4.3	4.3	4.9	6.7	9.7	12.7	13.1	12.1	10.2	8.1
H Mean . . .	3.9	3.4	3.4	4.3	5.7	7.1	9.1	11.7	13.2	11.6	8.4	5.9
A 1952 . . .	-0.1	0.8	0.2	0.3	0.2	1.4	-0.4	0.6	0.6	0.3	-0.4	0.5
H 1952 . . .	0.0	-1.4	-0.8	-0.2	-0.5	—	0.5	-0.4	0.2	-1.1	1.3	1.6

gat where the Baltic current usually prevails. Monthly means of temperature and salinity at surface and bottom in 1952, for the lightships mentioned, are presented in Table 1. Deviations from normal values, i. e., mean values for the observation period 1923—52, are also given.

Owing to the cool summer, surface temperatures in 1952 were less than normal during the the summer and the autumn. The high values of the bottom temperatures in June—September, particularly July, are a salient feature. This anomaly, which is most marked at the "Fladen" and the "Svinbådan", may be ascribed to intense vertical mixing and damming up of the Baltic current due to the action of strong westerly winds.

The temperature anomaly in the summer is associated with a salinity anomaly involving high surface salinity and low bottom salinity.

In July at the "Svinbådan" the bottom salinity was only 23.6 ‰ compared with the normal value of 29.8 ‰. The answer is chiefly afforded by the strong inflow from the North Sea in the summer 1952 induced by the westerly winds. During the last three months of the year an intensified outflow of Baltic water led to low surface salinities and inversely to high bottom salinities.

NILS JERLOV.

3. Danish Waters.

The remarkably strong penetration of salt water into the southern part of the Transition Area which took place in September—December 1951, was still appreciable in January and February, the monthly mean salinities at Gedser Rev lightvessel ranging from 3 ‰ to 5 ‰ above normal. In March the salinity was again

Table 3. Monthly Means of Residual Surface Currents in cm./sec. at the Lightvessel "Halsskov Rev". The current from the Baltic is stated as positive, towards the Baltic as negative.

(From the Danish Meteorological Institute, Nautical Department)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1952	10.0	-4.4	23.3	8.2	-10.6	—	10.8	-0.9	5.9	12.2	13.8	23.2

nearly normal, but in the period April to September high salinities again prevailed with departures from normal monthly mean salinities of up to 6‰ in the bottom layer and up to 3‰ at the surface. In October—November the salinity was normal and in December somewhat below normal.

The monthly mean temperatures at Gedser Rev were about 1.5° above normal in January. During the rest of the year the deviations from

normal conditions were small, but in August a bottom temperature of 2.2° below normal was recorded.

The variations of temperature and salinity in the central and northern part of the Transition Area appear in Table 2.

The yearly average residual current at Halskov Rev in the direction of the Kattegat amounted to 8.3 cm./sec., (normal value 11.1 cm./sec.).

HELGE THOMSEN.

Benthic Food.

1. The Limfjord.

The quantity of bottom animals found, during the usual routine investigations in the Limfjord, is shown in the following table, which gives for the two most important broads the weight in g./m.² of the three groups of animals (1st class etc.; for explanation see Ann. Biol., Vol. III, p. 92).

	Livo Broad			Nissum Broad		
	1st class	2nd class	non-food	1st class	2nd class	non-food
Autumn 1951.....	22.3	75.1	70	17.0	118.6	95
Spring 1952.....	16.3	5.8	385	8.1	78.6	121
Mean.....	19.3	40.5	227	12.5	98.6	108
Mean 1928—50...	15.4	17.6	260	8.7	87.7	79

It is seen that in both areas the amounts of 1st- and 2nd-class plaice food are above normal, which in the case of the 1st-class food is due, *inter alia*, to the presence of considerable quantities of *Philine*. The group non-food was

a little below normal in Nissum Broad. It is remarkable that the heavy quantities of *Asci-diella aspersa* which have been present during the past years are now declining again. The reason for this fact remains obscure.

2. Other Danish Waters.

In various parts of the Transition Area small numbers of bottom samples were procured by means of the 0.1 m.² Petersen grab. The amount of 1st-class food appears from the following figures: —

	Isefjord	S. Belts
No. samples....	10	15
g./m. ²	26.7	18.2

Compared with 1951 the amount of 1st-class food was a little larger in the Isefjord, while it was a little smaller in the southern Belts.

J. KNUDSEN.

THE FISH

Eggs and Larvae.

1. Danish Waters.

Gadidae. Hauls with the 2 m. ring-trawl were carried out from February to June. In late February numerous cod larvae were found in the southern Kattegat and the Belts. In March, also, several cod larvae were found. The numbers per hour were as follows:—

Year	Skagerak	North Kattegat	Central Kattegat	South Kattegat
1952, March.....	27 (5)	74 (9)	80 (6)	96 (1)
1951, —	0 (2)	1.8 (18)	1.4 (7)	—

For comparison the numbers found in the same waters in 1951 are given, and in brackets the number of hauls.

In April and May the following numbers of cod larvae per 1 hour's fishing were found (in brackets number of hauls):—

Year	April			May		
	Central Kattegat	South Kattegat	Belts	Belts	West Baltic	
1952.....	115 (3)	28 (4)	36 (1)	168 (16)	18 (3)	
1951.....	—	9.6 (4)	24 (30)	5.2 (16)	—	
1923—39..	—	54	45	32	42	

It is seen that the number of cod larvae in April was a little below the means for 1923—39, but above the numbers in 1951. This was also the case in May, where many cod larvae were taken in the Belts. In June there were very few cod larvae in the Danish waters, but many whiting larvae were found in the southern Kattegat in this month.

Flatfish. In February a few plaice and flounder larvae were taken with the ring-trawl. In March the following numbers of plaice larvae were found (in brackets: number of hauls):—

Year	Skagerak	North Kattegat	Central Kattegat
1952, March..	2.4 (5)	4.3 (9)	1.0 (6)
1951, — ..	7.0 (2)	2.8 (18)	0 (7)

In these northern parts of the Danish waters the figures are similar to those of the previous year: in the Skagerak a little below and in the Kattegat a little above. In the central Kattegat some flounder and dab larvae were caught. In 1951 there were none.

It is seen from the following list that the numbers of plaice and flounder in April and

May in 1952 were exceeding both the numbers in 1951 and the average value 1935—39. Especially many flounder larvae were found this year, (in brackets: number of stations):—

	Central Kattegat	April South Kattegat	Belts	May Belts
Plaice 1952.....	5.0 (3)	0.8 (4)	3.0 (1)	0.2 (16)
— 1951.....	—	0 (4)	0 (30)	0 (16)
— 1935—39....	0.2	0.4	0.6	7.2
Flounder 1952.....	13 (3)	26 (4)	39 (1)	2.1 (16)
— 1951.....	—	0 (4)	4.4 (30)	0 (16)
— 1935—39..	0.5	1.2	1.4	1.0

According to these results it seems that 1952 has given rise to good year-classes of cod, plaice and flounder.

J. B. KIRKEGAARD.

2. German Waters.

Cruises were made in Kiel Bay with the R. S. "Südfall" of the "Institut für Meereskunde der Universität Kiel". Vertical hauls by means of the Hensen egg-net and horizontal hauls in the deeper water layers with the Petersen young-fish-trawl were carried out.

Cod. The mean number of cod larvae per m.² and calculated per 1/2 hour is given below (in brackets: number of stations):—

1952	1.-4. April	28.-29. April	14.-17. May
per m. ²	3.4 (8)	2.0 (12)	0.9 (20)
per 1/2 hour.....	114.0 (7)	87.0 (12)	162.0 (7)

These numbers indicate a good brood year.

Flatfish. The number of flatfish larvae caught in April and May was very small, no plaice larvae and few flounder larvae were found. From the middle of June dab larvae became more numerous, especially in the neighbourhood of the Great Belt (up to 21 per m.²). This is an indication that a considerable number of dab fry is carried by the under-current to the Belt Sea from the north.

1952	17.-19. June	16.-19. July	7.-9. Aug.
per m. ²	2.3 (6)	4.5 (16)	0.7 (15)
per 1/2 hour.....	5.0 (6)	50.0 (8)	8.0 (9)

Mackerel. Particular attention was paid to the mackerel. Their spawning in Kiel Bay has been observed regularly for the last 20 years.

The numbers of eggs and larvae caught appear from the figures below.

1952	5.-7. June	17.-19. June	16.-19. July
per m. ²	(11)	(7)	(16)
Eggs.....	2.0	23.4	4.0
Larvae.....	0	3.7	0.1
per 1/2 hour.....	(6)	(6)	(8)
Eggs.....	78.0	256	201
Larvae.....	0.3	12	0

Eggs, just spawned, and newly hatched larvae were found over the whole area of Kiel Bay right to the entrance of Flensburg and Kiel fjords. They were most numerous, however, chiefly in the north-eastern part of the bay near the Great Belt and the Fehmarn Belt. The occurrence of young mackerels from the spawning has not been observed so far in the autumn months, and it seems that the brood, after having thrived at the beginning, died off later.

R. KÄNDLER.

Gadidae:

1. The Norwegian Coastal Waters.

The fjords between Kragerø and Mandal.

The ordinary experimental fishing in the littoral region in September and October gave the following average numbers per haul of the 0- and I-groups:—

70—75 hauls	Cod		Whiting	Pollack
	0-Gr.	I-Gr. ¹⁾	0-Gr.	0-Gr.
1917—29.....	19.9	2.2	14.8	23.1
1930—39.....	7.2	1.1	16.3	8.3
1940—49 ²⁾	4.7	1.0	30.1	8.8
1950.....	4.2	0.9	19.0	3.0
1951.....	1.9	1.2	18.2	2.6
1952.....	8.1	0.2	26.2	4.1

¹⁾ A few older specimens may be included.

²⁾ The series are incomplete during the war. The few hauls made in 1940—44 are not included.

The decadic means indicate that the 0-group of cod is getting scarce. The values for 1952 are, however, higher than those for the preceding years. With regard to the whiting the values keep relatively constant. The pollack varies as the cod.

The Oslofjord.

Outside Drøbak the number of the 0-group cod is decreasing from 1936. The values for 1952 are higher than for the two preceding years. The number of whiting varies to a

considerable degree. The number of young pollack is nearly constant.

	Cod				Whiting		Pollack	
	0-Gr.		I-Gr. ¹⁾		0-Gr.		0-Gr.	
	A	B	A	B	A	B	A	B
1936—39...	50.2	18.8	3.0	2.8	9.8	7.6	4.5	5.0
1940—49 ²⁾ ..	33.5	2.6	2.5	2.8	38.0	7.4	6.7	0.7
1950.....	14.2	0.04	3.0	0.2	16.7	1.0	3.2	0.1
1951.....	3.9	0	1.3	0	6.1	1.5	2.6	0.7
1952.....	16.8	0	0.9	0	31.2	0.6	5.5	1.7

A = Outside Drøbak.

B = Inner Fjord.

¹⁾ A few older specimens may be included.

²⁾ The series are incomplete during the war. The few hauls made in 1940—44 are not included.

In the inner Fjord the cod is here getting very scarce, and so are the whiting and pollack.

	1921	1930	1940			
Average	—29	—39	—49	1950	1951	1952
Cod per trap	70	63	91	101	87	8

The experimental fishing with traps for the older cod at Flødevigen resulted in 85 cod per trap, mostly 1950 and 1951 year-classes.

ALF DANNEVIG.

2. Danish Waters.

Cod.

From the fishing experiments with the eel-tog, which were carried out from the end of February to the beginning of December (see Table 4) it appears that in the Kattegat the stock of cod was extremely poor, a stock of 0-groups being met with only in the southern Kattegat. In the Sound the 0- and I-groups were absent, but a small quantity of II-group fish were obtained and the quantities of III-group fish and older were about normal. It should, however, be taken into consideration that in the waters mentioned the number of hauls with the eel-tog was very small, owing to the fact that in recent years a more wide-meshed gear, a cod trawl, has been introduced in the experimental fishing carried out in the Transition

Table 4. Number of Cod caught per 1 Hour in the Eel-Tog.

The figures in italics are the means for the 10-year period 1930—39. For the 0-group (year-class 1952) only catches made after 1. June are considered.

Age-group	0	I	II	III	IV +	All
Year-class	1952	1951	1950	1949	Older	year-classes
	No. of Stat.					
C. Kattegat	3 0 47	0 4.0 0	2.0 0	0.8 0	0.2 0	54
S. Kattegat	4 25 16	0 15 0	3.2 0	2.4 0	1.0 25	32
Sound....	1 0 13	0 24 8	24 8	9.0 4	4.0 20	69
Belts....	21 28 32	19.5 12	1.7 4.0	0.9 3.0	0.1 1.0	50 38

Area. However, the hauls with the cod trawl showed that although the waters mentioned had a stock of a larger size than indicated from the above, which comprised individuals of I, II and older age-groups, the stock of cod in the Kattegat was inferior to that found in the Belts, the Sound and the western Baltic.

In the Belts the eel-tog fishery showed the existence of a supra-normal stock of 0- and I-group, while the quantity of older age-groups was below normal. This tendency has been prevailing now for a number of years and is no doubt due to a too heavy fishery upon small sized cod for fillet factories.

J. KNUDSEN.

Whiting.

The number of whiting caught per hour's fishing with the eel-tog (the number of hauls in brackets) were as follows:—

	1952	1951	Average 1927—39
Kattegat, Sound..	7.4 (7)	5.5	42
Belt Sea.....	30 (20)	26.1	12

It appears that in the Kattegat and the Sound the stock of whiting was poor, just as was also the case in 1951. Both years yielded an output far below the average for the period 1927—39. It should be noted, however, that in the later years the number of hauls with the eel-tog has been rather small, and further that most hauls with this gear have been made in places where the stock of whiting is generally not very dense.

A better idea of the density of the stock is gained from the hauls made with the trawl. The numbers per hour's fishing were as follows:—

	Number of stations		Number per hour	
	1952	1951	1952	1951
Skagerak.....	3	3	3.3	1.3
N. Kattegat.....	27	14	44	58
C. Kattegat.....	9	4	14.6	0
S. Kattegat, Sound.	32	21	19	63
Belts.....	49	55	95	51
W. Baltic.....	4	9	46	5.5

It will be seen that in the northern Kattegat the stock appears to be somewhat less in 1952 than in 1951, while in the southern Kattegat and the Sound the stock has decreased considerably. Both in the Belts and in the western Baltic the stock was larger in 1952 than in the previous year.

As is usually the case, the stock mainly consists of individuals of the 0- and I-groups, these groups forming in total about 90% of the stock. During the later part of the summer and the autumn some hauls yielded considerable numbers of 0-group whiting.

J. KNUDSEN.

Haddock.

During the summer of 1952 small quantities of 0-group haddock were obtained by the trawl (see Table 5). They appeared in the hauls carried out in the northern Kattegat during the latter part of July. In the southern Kattegat and northern Belt Sea they were found for the first time in September, while no haddock were obtained in the Sound and the southern Belt Sea until November and December, respectively. It should be added, that no haddock larvae were found in the hauls with the ring-trawl made in the various parts of the Transition Area during the spring and early summer.

As also found in previous years, the growth of the 0-group was, at least, as fast as in the North Sea.

The haddock does not spawn to any extent in the Transition Area but larvae have in some years been carried in from outside with influx of saline water. A review of the occurrence of haddock in the areas has been given by POULSEN in Rapp. et Proc. Verb. 102, III,

Table 5. Number of 0-Group Haddock per Hour's Trawling.

(— means no investigation. The number in brackets indicates number of hauls. Only hauls after 1. July have been considered).

Month:	VII	VIII	IX	X	XI	XII	Mean
Northern Kattegat	2.2 (7)	9.5 (7)	—	—	2.6 (13)	—	4.3 (27)
Central Kattegat	—	22.6 (3)	0 (1)	—	0 (4)	—	8.4 (8)
Southern Kattegat	—	0 (5)	4 (2)	2 (10)	1.5 (4)	0 (3)	1.4 (24)
Northern Belts	—	—	0.4 (5)	1.4 (11)	0 (2)	2 (2)	1.0 (21)
Southern Belts	—	0 (6)	0 (6)	—	—	0.9 (7)	0.3 (19)
Western Baltic	—	—	—	—	—	0 (2)	0 (2)
Sound	—	0 (6)	—	—	3.5 (4)	—	1.4 (10)

Table 6. Length Distribution of 0-Group Haddock in Relation to Month.

Month: cm.	VII	VIII	IX	X	XI	XII
8.....	1	8	—	—	—	—
9.....	1	29	—	—	—	—
10.....	4	21	1	—	—	—
11.....	2	8	0	—	—	—
12.....	—	1	1	—	—	—
13.....	—	—	0	—	—	—
14.....	—	—	1	—	—	—
15.....	—	—	1	4	2	1
16.....	—	—	0	1	5	0
17.....	—	—	1	6	4	0
18.....	—	—	—	4	6	3
19.....	—	—	—	3	8	1
20.....	—	—	—	—	1	—
21.....	—	—	—	—	1	—
Total.....	8	67	5	18	27	5
Av. length, cm. .	10.4	10.0	14.1	17.6	18.3	18.1

p. 10. It appears that only in a single year, 1923, was the number of fry of haddock in the Transition Area so great as to give rise to an important fishery 2 and 3 years later. In 1928, 1929, and 1932 smaller numbers of larvae were obtained in the 1-m. ring-trawl, but later on older haddock failed to appear either in the experimental hauls or in the commercial fishery. Unfortunately it is not possible to draw comparisons between the magnitude of the stock present in 1952 and those of the previous years mentioned above. It is, from the available data, impossible to make any prediction whether the stock, providing it remains in the Transition Area, will give rise to a fishery of equal importance as that resulting from the 1923-influx. It seems justifiable, however, to assume that the size of the stock of 0-group haddock during 1952 was not quite insignificant.

J. KNUDSEN.

Plaice, Flounder, and Turbot.

1. Coastal investigations. 0- and I-groups.

The number of 0-group plaice caught with a Johansen young-plaice-trawl was (see Table 7) a little below the normal in the northern Kattegat, but about double the normal in the central and southern Kattegat. It was 5 and 7 times the normal in the Belts and the western Baltic, respectively. On the Swedish coast of the southern Kattegat the quantitative fishing was allowed to be carried out from Denmark, by courtesy of the Swedish fishery investigations, and showed a normal density of 0-group plaice, which was also found in the Sound.

Table 7. Number of Plaice and Flounder caught per Hour.

In italics: mean for 1927—52 on the Danish coasts, for 1929—38 on the Swedish coasts.

	No. of		Plaice		Flounder	
	Stat.	0-Group	I-Group	0-Group	I-Group	0-Group
N. Kattegat.....	10	56	77	10	26	0 0.6
C. Kattegat.....	21	62	29	0	4	2 1
S. Kattegat (Danish).....	17	38	24	0	0.8	8 0.4
— (Swedish).....	21	191	192	0	2	4 104
Sound.....	19	10	9	0	1	1 20
Belts.....	78	62	12	0	0.9	6 8
Western Baltic.....	11	43	6	0	0.2	0 4

The number of 0-group flounder was very much above the mean on the Danish coasts of the central and southern Kattegat but very much below the mean on the Swedish coast of the southern Kattegat, where the density is normally very much higher than at the Danish coasts. In the Belts it was about the mean.

As is most frequently the case, the number of young turbot caught on these coasts was very small.

2. The stock of plaice in the open sea.

Results of the quantitative fishing carried out from S/S "Biologen" with the eel-tog and a 50-foot trawl as standard gears are shown in Table 8.

The trawl has, on an average, taken 3 times as many plaice per time unit as the eel-tog, judging from 44 comparative hauls in 1951—1952.

Using this ratio it will be seen that there was a good correspondence between the results obtained by the two implements.

The main facts to be learned from the figures in Table 8 are that the 0-group in the Belts was more strongly represented than normally, and that the I-group and older fish were more sparse than normally. The high frequency of the 0-group in the Belts corresponds with the results by fishing with the Johansen young-plaice-trawl, but it is only in recent years that the 0-group has been taken in such great numbers at these depths. Now it must be admitted that rather little fishing has been carried out, with the eel-tog or fine-meshed trawls, during the autumn of former years, so actually, we do not know if a change in the habits of the 0-group plaice has taken place.

From the coastal fishing experiments we would have expected the 1951 year-class to have been normal in the Skagerak, and the 1950 year-class only a little below. This may agree with the results of the few hauls in this region.

Table 8. Number of the various Age-Groups of Plaice caught per 1 Hour with Eel-Tog and with Trawl.

Means in brackets. The 0-group means have been calculated from the number of stations after 1. July; the other means are those for 1927—39. Trawl means = 3 eel-tog means.

	No. of Stat. ¹⁾	Age-groups				
		0	I	II	III	IV +
		Year-class				
		1952	1951	1950	1949	1948—
Eel-tog						
C. and S. Kattegat						
5—14 m....	3 (2)	0 (3)	0 (20)	1 (15)	0 (1)	0 (0.1)
15—34 m....	3 (1)	0 (0)	0 (0.7)	4 (0.3)	8 (0.2)	4 (0.4)
Belts						
5—14 m....	3 (3)	250 (3)	2 (7)	0 (5)	0 (2)	0 (0.2)
15—34 m. .	18 (16)	6 (0.4)	0.5 (1.6)	2 (1.5)	0.7 (0.6)	0 (0.3)
Trawl						
Skagerak						
5—14 m....	2 (2)	0	101	220	1	0
15—24 m....	1 (1)	0	10	50	1	0
N. Kattegat						
5—14 m....	3 (3)	0 (27)	8 (483)	63 (459)	0 (132)	0 (4)
15—24 m....	6 (6)	0 (0.6)	2 (228)	59 (351)	7 (147)	0 (2)
25—34 m....	4 (4)	0.5 (0)	3 (9)	56 (87)	5 (27)	0 (2)
35—44 m....	7 (7)	0 (0)	0 (0.6)	9 (4)	1 (4)	0 (1)
> 45 m. . .	8 (8)	0	0	0.2	0.5	0
C. and S. Kattegat						
5—14 m....	4 (4)	0 (9)	0 (60)	1 (45)	0 (3)	0 (0.3)
15—34 m....	31 (21)	0 (0)	0 (2)	2 (1)	2 (0.6)	0.6 (0.1)
> 35 m. . .	4 (4)	0	0	2	0.5	0
Isefjord						
7—10 m....	7 (4)	6	0.9	2	0.6	0.9
Sound						
15—24 m....	8 (7)	0.9	0	7	9	5
25—34 m....	5 (4)	0	0	1	14	5
Belts						
5—14 m....	8 (6)	22 (9)	4 (21)	3 (15)	0.2 (6)	0 (0.6)
15—34 m....	38 (34)	5 (1)	2 (5)	4 (4)	1 (2)	0.2 (1)
35—44 m....	2 (1)	0	0	0	2	1
W. Baltic						
5—14 m....	1 (1)	0	2	2	0	0
15—24 m....	3 (3)	0.7	0.7	1	1	2
25—34 m....	3 (1)	0	0	0.7	1	0

¹⁾ Figures in brackets denote number of stations after 1. July.

On the other hand in the northern Kattegat the 1950 and 1951 year-classes as 0-groups were found to be more numerous than normal, but in 1952 their density was below normal, especially that of the 1951 year-class; in the central Kattegat only, the 0-group of the 1951 year-class was about normal in the coastal fishing experiments, whereas the others were below normal. From the strength of the 1950 and 1951 year-classes as 0-groups an improvement in the commercial catches during 1953 might be expected, but now it is seen that they have been thinned so vigorously that they cannot help the fishery very much.

In the southern Kattegat each of the year-classes back to 1948 has been below normal, in the Belts the 1950 year-class was about normal, and in the western Baltic and the Sound above normal. In 1952 the density of these year-classes, which originally was normal or above normal, was then below normal.

It had been hoped that the increasing fishery for fish for processing would have diminished the depletion of the stock of plaice but obviously this hope has failed. It must be expected that the yield of the plaice fishery in the Belts will decrease until the plaice of the 1952 year-class reach the size limit; but considering the very heavy depletion of the stocks of the previous year-classes it must be feared that the beneficial effect of this year-class will be rather slight.

Another fact to be seen from Table 8 is that comparatively many of the older year-classes were found only in the Sound, where fishing with seines and trawls is prohibited.

3. Market measurements of plaice.

From Table 9 it appears that the mean length of the plaice caught at the Skaw in the autumn of 1952 was $\frac{1}{2}$ —4 cm. less than in 1950 which corresponds with the recruiting of the stock of commercial fish in 1952 being from stronger year-classes than in 1950. It also appears that the mean length had increased $\frac{1}{2}$ —2 cm. from the beginning of 1950 to 1952 in the southern Kattegat and the adjoining parts of the Belts, which is in good accordance with the fact that the good year-class 1948 constituted the main part of the catch in 1950, and the other year-classes occurring in the catch had been poor. In 1952, however, the younger plaice originated from year-classes of under normal strength.

AAGE J. C. JENSEN.

Table 9. Length Composition of Plaice (%) fished commercially in Kattegat and Belts.

								Length, cm.							
Depth,		26-	31-	36-	41-			Depth,		26-	31-	36-	41-		
m. Gear		30	35	40	45	Mean		m. Gear		30	35	40	45	Mean	
East of the Skaw								At Hjelm							
1950, Nov.—Dec.....	9	N	65	28	7	—	30.4	1950, Feb.....	21	DS	54	34	11	—	31.2
1952, Nov.....	9	N	75	24	2	—	29.8	1952, Feb.—March.....	22	DS	42	46	12	—	31.8
1950, Nov.....	17	DS	27	64	9	—	32.8	8—12 miles W. of Anholt							
1952, Nov.....	15	DS	85	9	5	—	28.5	1950, Feb.....	22	DS	77	23	—	—	29.6
NE. of Fornæs								1952, March.....	17	DS	49	45	5	0.4	31.1
1950, March.....	18	DS	75	16	9	0.5	30.2	At Schultz's Grund L. V.							
1952, Feb.—March.....	18	DS	44	42	13	0.6	31.8	1950, Feb.—March.....	24	DS	68	17	11	3	30.7
7—8 miles E. of Grenå..								1952, Feb.....	17	DS	57	30	11	3	31.4
1950, Feb.....	19	DS	85	13	2	—	28.9	(DS: Danish seine, N: Net).							
1952, March.....	20	DS	58	33	7	2	31.0								

(DS: Danish seine, N: Net).

4. The Limfjord stock of plaice.

As in previous years investigations concerning the stock of fish in the Limfjord were carried out by means of the eel-tog in June and September.

The number of plaice caught per hour's fishing in various parts of the Limfjord were as follows (the means for the period 1927—51 are given in italics):—

	Nissum Br.	Venø- Kås Br.	Sal- ling- sund	Livø Br.	Thisted- Visby Br.	E. of Salling
June... 390 670	48	118	4 86	8.2 9.6	4.6 14	1.0 5.8
Sept... 608 928	6.4	118	0 34	0.2 4.0	2.0 4.0	0 1.4

It is seen that the stock of plaice in all parts of the Limfjord in 1952 was below normal, both June and September.

Age determinations in Nissum Broad showed this composition:—

Age-group	Year-class	June	September
0.....	1952	— —	214 60
I.....	1951	19 160	152 390
II.....	1950	356 290	262 348
III.....	1949	17 182	8.8 116
IV +.....	1948	0.6 38	0 22

The figures are numbers per hour's fishing with the eel-tog (in italics: means for 1927—51).

It appears that the 0-group was much above normal and promises a numerically strong 1952 year-class. Of other age-groups only in June was the II-group somewhat above normal. In the autumn this year-class was the most numerous too, but a little below normal. The I-group was far below normal and the older age-groups were very poorly represented.

As in 1951 fishing experiments with the eel-tog were carried out in Nissum Broad just before one million young plaice were caught for transplantation.

The age composition was, before and after the transplantation, as follows (catches per hour):—

	I-Gr.	II-Gr.	III-Gr.	IV + -Gr.
March.....	1.6	136	32	6
June.....	19	356	17	1.2

As it is the II-group which is mainly fished upon (70%, see transplantations of plaice), the table shows that the stock of plaice in Nissum Broad is not affected by the transplantations. The great difference between the figures must for some part be attributed to the fact that the plaice in early spring are lying hard to the bottom.

J. B. KIRKEGAARD.

5. Transplantation of plaice.

a. Belt Sea. In 1952, for the first time since the war, the transplantation of young plaice to the inner Danish waters was carried out from Esbjerg. This method was used for several years before the war. The plaice were fished off Esbjerg and transported overland to Fredericia in ordinary fish-boxes. From here they were carried to the places of liberation by well-smacks.

The following quantities were liberated in various parts of the Danish waters:—

	Isefjord	The Sound	Belt Sea		W. Baltic	Total
Tons.....	7.9	4.2	20.9	29.1	10.5	72.6
Thousand fish.....	66	35	176	245	88	610

As usual, samples were examined for age, length and number of anal fin rays:—

Age-group	Year-class	Number analysed	%	Mean length, cm.	No. of anal fin rays
II.....	1950	35	6	19.8	—
III.....	1949	304	51	22.2	53.89
IV.....	1948	161	27	24.4	53.90
V.....	1947	95	16	24.9	53.46
VI.....	1946	4	1	—	—

It appears that the III-group was the most important here. As will be shown below, the II-group predominated in the Limfjord. The average length was 23.1 cm. in the Belts and 19.9 cm. in the Limfjord.

The transplantations were finished on 9. May and the temperature at this time was comparatively high. For this reason many of the plaice died, so the results of the marking experiments were not very good. Of 1100 plaice marked 12% had been recaptured at the end of the year.

b. Limfjord. In the Limfjord the transplantations were continued in the same way as in previous years. From the end of March to the beginning of April 84 tons or 1 million individuals were caught in Nissum Broad and carried by well-smacks to the inner broads.

As in the Belt Sea, samples were examined for age, length and number of anal fin rays:—

Age-group	Year-class	No. analysed	%	Mean length, cm.	No. of anal fin rays
II.....	1950	499	69	18.8	53.98
III.....	1949	206	28	22.1	54.80
IV.....	1948	23	3	23.7	—

The mean length of the II- and III-group, this year, was about 1 cm. above last year's mean length of the same age-groups. The plaice will be bigger and bigger from year to year as a result of the sparse population in Nissum Broad during the later years.

The weather conditions were very fine. During the transplantation the temperature in the water was about 1—2° C.; 1000 plaice were marked; 64% were recaptured at the end of the year. This is still better than in the immediately preceding years (1951: 40%, 1950: 26%). In one experiment in Thisted Broad 84% were recaptured.

J. B. KIRKEGAARD.

6. Flounder and turbot in the Limfjord.

The number of flounder caught per hour's haul with the eel-tog in various parts of the

Limfjord was as follows (in italics: means for 1927—51):—

	Nissum Br.	Venø-Kås Br.	Sal-ling-sund	Livø Br.	Thisted-Visby Br.	E. of Salling
June.	0.6 0.8	6.0 2.0	0 2.0	3.4 5.2	2.2 3.0	0 5.2
Sept..	0 0.2	0.4 0.6	0 1.2	1.4 4.0	1.0 1.2	4.0 1.4

Again, the density of the stock of flounder in the Limfjord was this year below normal. Only in summer was it somewhat above normal in Venø-Kås Broad and in autumn E. of Salling. Still the number of flounder was a little higher than in the immediately preceding years.

The number of turbot caught was very small. In Livø Broad the stock was far below normal; in Sallingsund and Thisted Broad it was a little above normal.

J. B. KIRKEGAARD.

Dab.

1. Limfjord stock.

The number of dabs per hour's haul with the eel-tog in the different parts of the Limfjord was as follows:—

Nissum Br.	Venø-Kås Br.	Salling-sund	Livø Br.	Thisted-Visby Br.	E. of Salling
114 134	2.2 32	6.6 22	2.6 2.4	0.0 1.0	0.6 0.6

The numbers are means of summer and autumn investigations. In italics are the means for 1927—51.

The average for the whole Limfjord was very close to the average of 1951, which was the largest since the war. Still the stock of dabs is far below normal in most parts of the Limfjord.

J. B. KIRKEGAARD.

2. Other Danish Waters.

The quantitative fishing with the eel-tog showed that the stock of dabs was considerably below normal. The number caught per 1 hour's fishing in the different areas was as follows:—

	Number of hauls	Number per hour	Aver. number per hour 1930—39
N. Kattegat.....	0	—	310
C. Kattegat.....	3	15	69
S. Kattegat.....	4	15	127
Belts.....	21	74	176

It appears that in all areas the decrease of the stock is very considerable. This decrease has been a characteristic feature in the stock of dabs for a number of years since 1945. This is clearly demonstrated by the following figures, giving the number of dabs caught per 1 hour's fishing with the eel-tog, in the southern Kattegat and the Belts during the period 1949 to 1952:—

	Mean 1930—39	1949	1950	1951	1952
S. Kattegat . . .	127	93	104	39	15
Belts	176	152	60	69	74

It is seen that when a regular investigation of the areas started after World War II the stock was somewhat below normal and that a heavy decrease happened in the Belts in 1949/50 and a similar decrease was found one year later in the southern Kattegat.

The quantitative fishing with the cod trawl yielded much larger quantities of dabs, as appears in the following table giving the number per 1 hour's fishing:—

	Number of hauls	Number per hour '52	Number per hour '51
Skagerak	3	110	150
N. Kattegat	28	221	174
C. Kattegat	11	81	73
S. Kattegat	32	167	206
Belts	56	191	141
W. Baltic	4	73	36

It appears that compared with the previous year, 1952 gave larger quantities of dabs in the northern and southern Kattegat, the Belts and W. Baltic, while fewer were obtained in the Skagerak and the southern Kattegat. It should be noted that as far as the southern Kattegat and the Belts are concerned the results obtained with the cod trawl fit in well with those obtained by means of the eel-tog.

In the majority of the specimens obtained, age determinations have been carried out by examination of otoliths. The following table gives the results of the determinations made on the eel-tog material (year-class in brackets):—

	Total number of specimens examined	I-Gr. (1951) %	II-Gr. (1950) %	III+ -Gr. (1949—) %
C. Kattegat . .	46	54	35	11
S. Kattegat . .	10	60	40	0
Belts	830	63	30	8

As in previous years the stock consists mainly of young fish of the I- and II-groups.

In the central Kattegat the percentage of the I-group was smaller than in 1951, while in the Belts the stock had almost the same age composition in 1952 as in 1951.

J. KNUDSEN.

Fish for Processing.

The Danish fishery for fish-meal factories, fish-pond food, and food for fox farms did not show so great an increase as in the preceding years (see Table 10).

Table 10. Catch (in tons) of Fish for Processing in the various Danish Waters.

	1950	1951	1952
North Sea	6,811	34,000	32,859
Skagerak	29,067	47,000	65,948
Kattegat	21,522	23,000	22,528
Sound	—	3	1
Belts	2,856	3,200	3,830
Western Baltic	51	110	164
Eastern Baltic	118	110	136
Ringkøbing Fjord	5	16	6
Nissum Fjord	7	15	13
Limfjord	1,680	2,500	3,847
Total	62,117	109,954	129,332

The greater part of the fish was caught in Skagerak, North Sea and Kattegat and the main landing ports were Skagen, Esbjerg and Frederikshavn. From the figures it will be seen that the yield in Skagerak has increased, while the yield in North Sea and Kattegat shows a lesser decrease. In the Limfjord the yield of fish for processing has increased by ca. 50%.

In the summer and autumn the landing of small herring for processing (8—14 cm.) from a few pound nets, was allowed by special license on the north coast of Djursland, in order to get information as to the catches. Five samples from this fishery were examined at the laboratory of "Danmarks Fiskeri- og Havundersøgelser". The catches consisted of herring, sprat, small garfish and mackerel, whiting and weever, (see also Herring Report, p. 208).

During the year 13 samples of fish for processing from the northern area (Skagerak and northern Kattegat) and 48 samples from the southern area (southern Kattegat and the Belt Sea) were investigated partly at the ports and partly at the laboratory, and Table 11 shows the percentage abundance by weight of species found in the samples from the different areas. The Kalundborg fjord fishery is as usual given in a separate column, because this fishery is

Table 11. Percentage Distribution by Weight of Species in Samples of Fish for Processing in 1952.

Area:	Northern Area		Southern Area excl. Kalundborg Fjord 1. I.-15. IV and 1. X.-31. XII				Kalundborg fjord 15. IV.-30. IX	Lim-borg fjord Throughout the year
Period:	The whole year		11-14	16-18	12-15	16-18	12	18
Mesh, knot to knot, mm.	11-14	16-18	12-15	16-18	12	18	18-20	11
No. of samples	11	1	26	13	1	2	6	1
Whiting . . .	35.1	50.6	27.0	32.9	—	—	ca. 99 ¹⁾	—
Herring	32.3	1.3	35.2	44.0	4.8	—	+	89.7
Sprat	20.7	—	36.1	21.6	95.2	100	+	10.3
Other food fishes	3.8	22.6	0.6	0.6	—	—	—	—
Other fishes .	7.8	25.3	1.0	0.8	—	—	—	—
Invertebrates	0.4	0.2	+	+	—	—	+	—

¹⁾ In the samples investigated, 100 %, but small quantities of other fish had been sorted from the material beforehand.

carried out with a more wide-meshed gear and the catches always consist almost of whiting only.

In one sample caught north of the Skaw with a 16—18 mm. meshed gear it appears that 22% of the weight was small haddock, 14—21 cm., evidently all 0-group. From a report from the

fishery control in Frederikshavn it appears that by 10 of the very numerous investigations of the landings of fish for processing during the period 23. February to 25. November 1952 up to 48% haddock under the minimum size limit (30 cm.) were found at the ports of Hirtshals and Frederikshavn.

I. BOHUS JENSEN.

Hatching and Rearing.

The cod hatchery was not worked in 1952. Experimental rearing of plaice was, as usual, a great success. The rearing of herring and cod succeeded for a few months. The herring reared in 1951 in one of our largest aquaria lived till late in summer 1952. Then the mortality became very high and the experiment was discontinued. The cause of the mortality was not ascertained, but the symptoms indicated a lack of vitamins in connexion with parasites.

The rearing of lobster was carried out on a small scale. Experiments were undertaken to hatch eggs taken from the berried lobster. When the eggs were fully ripe the hatching was successful, but if the eggs were less so, the mortality was great and the larvae were not fully developed.

ALF DANNEVIG.

SHELLFISH

Lobster.

On the coast between Kragerø and Lista we have, for many years, collected precise information about the catches by 25 to 30 fishermen. The table gives the number of lobsters more than 21 cm. per gear used.

Average	Jomfruland-Risør	Arendal-Ulvøysund	Skogsøy-Lista
1928/39	10.2	5.8	3.2
1940/49	14.6	6.5	4.3
1950	13.8	6.9	4.1
1951	14.0	7.6	4.4
1952	8.7	6.2	4.6

It will be noticed that the number is very high in the eastern and low in the western

districts. The fishermen in the east use relatively few pots and fish for a relatively long part of the season. In the western district, however, the fishermen use a larger number of pots, but only fish for a few weeks. From year to year there is no special trend in the figures. In the eastern district, however, the catches are relatively low in 1952.

Oyster.

The oyster thrived in the natural ponds, and in the artificial pond at Flødevigen we had a good spatfall. In 1950, after we introduced a new method the results in the pond have been very promising.

ALF DANNEVIG.

Baltic Area.

INTRODUCTION

Contributions to this report have been received from Dr. AAGE J. C. JENSEN, Copenhagen, Mr. HELGE THOMSEN, Copenhagen, Dr. F. KOCZY, Gothenburg, Dr. G. ALM, Drottningholm and Dr. STEN VALLIN, Drottningholm.

Environment.

Both THOMSEN's and KOCZY's contributions indicate that the influx of water through the Sound and the Belts must have been much weaker during 1952 than in 1951 when the salinity in the Bornholm Deep showed an extraordinary increase. The salinity in this basin was still high in 1952 and in that year the salinity of the bottom layer in the Gotland Deep and the Landsort Deep had also risen considerably, which seems to indicate that the above-mentioned influx into the southern Baltic had now also reached the basins in the central part of this sea. Also, in the upper water layers the salinity seems to have been more or less above normal all over the Baltic in 1952. During the first half of the year the surface temperature was somewhat above normal but below normal in the autumn and winter.

JENSEN has continued his observations on the fat content of the plankton in the Bornholm district. He found that the fat content in 1952 was higher than in 1951 which he ascribes to the strong influx of water in the winter 1951/52.

In 1950 and 1951 *Eurytemora hirundoides* in the Gulf of Bothnia was infected by a parasitic water-mould and died in great masses. VALLIN has continued his investigations on this mould in 1952. No mass-destruction of *Eurytemora* was reported during this year but VALLIN found some plankton samples with occasional infected *Eurytemora*. It has been proved that the mould belongs to a new species of the genus *Leptolegnia*.

Fish Species.

JENSEN gives a survey of the Danish investigations on the recruitment and density of the stock of cod and flatfishes in the southern and western parts of the area. The stock of flatfishes is still low whereas the cod seems to maintain its strength.

ALM's contribution, which gives a survey of the Swedish salmon catches in the Baltic and Baltic rivers in the years 1940—1952 and the size groups of the salmon in the catches off Gotland 1946-1951 indicates a rather alarming development in this fishery. The total catch in the Baltic, as well as in the rivers, seems to have decreased but the percentage of small salmon in the catches in the central Baltic round Gotland seems to have increased during recent years.

CHR. HESSLE.

ENVIRONMENT

Hydrography.

Danish Observations.

Table 1. Monthly Means of Surface Temperature and Salinity at Christiansø, 1952.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature	5.0	3.0	2.2	3.7	7.0	13.1	15.5	15.9	13.1	9.9	7.4	5.0
Salinity ‰	8.3	8.1	8.0	8.0	8.1	8.0	8.0	7.8	7.8	7.8	7.5	7.3

The monthly mean temperatures of the surface water at Christiansø were slightly above normal during the first 7 months of the year. The greatest deviations occurred in January and June and amounted to 1.7° and 2.1°, respectively, in the remaining 5 months the deviations were less than 1°. In the period August/December, the monthly mean temperatures were below normal. The greatest deviations occurred in September and October and amounted to 1.0° and 1.2°, respectively.

A maximum salinity of the surface water was reached in January and amounted to 1.3 ‰ above normal. The salinity decreased steadily during the year, but in December the mean salinity was still slightly above normal.

The extremely high saline water, which entered the bottom of the Bornholm Deep by the end of 1951, remained there throughout 1952. The salinity at 100 m. decreased only slightly: from 20.57 ‰ in January to 19.85 ‰ in December, and the temperature remained between 7.78° and 7.42°.

Since no renewal of the bottom water took place, the oxygen content at 100 m. decreased

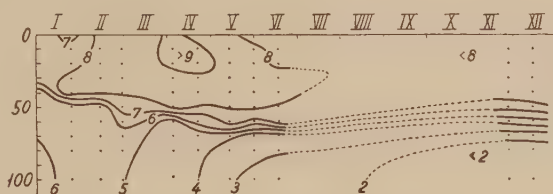


Figure 1. Isopleth diagram showing the variation of oxygen contents (ml./l.) in the Bornholm Deep, 1.5 naut. miles ESE. off Christiansø.

steadily from 86 % at the beginning of the year to 17 % by the end of the year. Details may be seen on the accompanying isopleth diagram, Figure 1.

HELGE THOMSEN.

Swedish Observations.

The Swedish lightships have carried out hydrographical observations since 1923. For most observed depths mean values of salinity and temperature were calculated. The calcula-

Table 2. The Surface Salinity at the Lightships and the Deviations from Mean Values.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Sydostbotten.....	5.50	—	—	—	4.72	4.92	3.93	5.01	4.74	4.90	5.81	5.45
Deviation.....	+0.1	—	—	—	-0.2	+0.2	-0.4	+0.7	+0.1	0.0	+0.6	+0.2
Finngrundet.....	5.57	5.66	5.75	5.78	5.76	5.73	5.47	5.39	5.61	5.53	5.54	5.60
Deviation.....	+0.2	+0.3	+0.3	+0.3	+0.4	+0.2	+0.1	+0.1	+0.4	+0.2	+0.1	+0.3
Grundkallen.....	5.67	5.63	5.67	5.75	5.75	5.63	5.66	5.60	5.47	5.69	5.44	5.44
Deviation.....	+0.3	+0.1	+0.2	+0.4	+0.3	+0.2	+0.5	+0.5	+0.3	+0.4	0.0	+0.1
Svenska Björn.....	6.43	6.50	6.04	6.05	5.95	5.91	5.93	5.77	6.27	6.23	5.91	6.13
Deviation.....	+0.2	+0.3	-0.2	0.0	+0.1	+0.2	+0.4	+0.3	+0.7	+0.3	-0.2	0.0
Hävringe.....	7.43	7.43	6.95	6.71	6.58	6.57	6.68	6.58	6.88	6.84	6.53	6.31
Ölandsrev.....	7.10	7.14	7.08	7.06	7.05	7.06	7.02	6.93	6.87	6.95	6.96	6.98
(1923-41, 1946-51)												
Falsterborev.....	9.64	9.44	9.34	8.07	7.95	8.50	8.41	8.58	8.98	9.50	8.20	8.24
Deviation.....	+1.4	+1.3	+1.5	+0.6	+0.6	+1.0	+0.5	+0.7	+1.0	+1.1	-0.1	0.0
Oskarsgrundet.....	11.73	9.39	10.34	9.18	8.32	16.94	8.85	8.71	11.18	10.39	11.54	8.44
Deviation.....	+0.6	-1.9	+0.1	-0.3	-0.1	+7.1	-1.0	-0.9	+0.4	-1.4	+1.0	-3.6

Table 3. The Bottom Salinity at the Lightships compared with the Mean Values.

	Depth, m.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Sydöstbrotten....	40	5.64	—	—	—	5.66	6.00	5.84	5.82	5.91	5.86	5.81	5.90
1948—52.....	40	5.74	—	—	—	6.08	5.79	5.85	5.86	5.80	5.80	5.74	5.77
1923—42.....	45	5.53	—	—	—	5.55	5.60	5.66	5.67	5.63	5.62	5.58	5.55
Finngundet.....	30	5.71	5.65	5.69	5.77	5.75	5.74	5.74	5.47	5.68	5.68	5.58	5.63
1948—52.....	30	5.76	5.71	5.78	5.67	5.71	5.73	5.79	5.72	5.75	5.74	5.65	5.71
1923—43, 45—52	20	5.45	5.40	5.50	5.48	5.45	5.47	5.47	5.42	5.37	5.35	5.37	5.33
Grundkallen.....	40	6.07	5.60	5.93	5.79	5.84	6.28	5.84	5.84	6.47	5.85	5.45	5.46
1948—52.....	40	5.88	5.93	5.90	5.98	5.85	6.00	5.98	5.94	5.76	5.84	5.83	5.97
1923—39, 46—47	50	5.71	5.68	5.73	5.70	5.71	5.84	5.88	5.80	5.81	5.80	5.75	5.60
Svenska Björn...	40	7.30	6.78	6.82	6.37	6.76	7.47	6.86	7.30	7.40	6.88	6.73	7.34
1948—52.....	40	6.88	6.68	6.77	6.81	6.81	7.35	7.28	7.72	7.24	7.31	6.92	6.80
1923—39, 46—52	30	6.34	6.38	6.41	6.31	6.25	6.20	6.19	6.20	6.26	6.42	6.34	6.29
Hävringe.....	40	7.93	7.50	7.14	6.90	7.02	7.65	7.59	7.34	7.88	7.32	6.89	6.94
Ölandsrev ¹⁾	45	7.36	7.38	7.29	7.16	7.17	7.35	7.43	7.39	7.31	7.44	7.51	7.39
1948—51.....	40	7.56	7.57	7.58	7.58	7.59	7.70	7.65	7.83	7.93	8.40	8.19	7.81
Falsterborev.....	10	12.65	9.44	9.35	8.07	7.95	8.51	8.75	8.67	9.16	9.50	8.94	8.24
Deviation.....	—	+4.2	+1.2	+1.5	+0.5	+0.5	+0.9	+0.7	+0.5	+0.9	+0.8	+0.6	—0.2
Oskarsgrundet...	8	18.04	9.42	10.34	9.56	8.31	18.35	8.85	9.12	11.18	10.39	25.26	15.88
Deviation.....	—	+4.5	—4.4	—3.3	—2.9	—1.5	+6.1	—2.6	—1.7	—1.5	—3.6	+11.1	+1.3

¹⁾ 1923—41, 1946—51.

tions were made for all years 1923-1952 except for the break during the war, but in addition, to obtain a survey of long-periodic changes, tables of mean values have been made up for four periods, viz., 1923-1928, 1929-1934, 1935-1941 and 1947-1952. These tables of mean values are published by the Fishery Board of Sweden in Series Hydrography together with a short discussion.

The hydrographical situation, as shown by the observations from the lightships (Tables 2—5) during 1952, is characterized by an exceptionally low surface temperature in September and October, being about 2 degrees

below the normal value. Also the two last months of the year were cold. On the other hand the surface water was warmer than usual in the southern Baltic during May and in the Bothnian Sea during June and July. The bottom layer in the Bothnian Sea shows higher values during September, whereas in the southern Baltic and the Sound the bottom values follow the surface values.

Considering the salinity values no exceptional deviation could be registered from the mean values of the last five years. The 20 ‰ front reached Oskarsgrund only once during the year, — in November, but did not penetrate

Table 4. The Monthly Mean Surface Temperature at the Lightships and the Deviations from Mean Values.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Sydöstbrotten.....	2.0	—	—	—	4.0	9.0	14.3	14.7	10.2	5.9	3.8	2.4
Deviation.....	—0.1	—	—	—	—0.4	+0.6	+0.2	—0.7	—1.7	—1.8	—1.0	—0.8
Finngundet.....	1.8	0.8	0.4	0.9	2.8	8.5	14.2	14.0	9.4	6.4	4.3	2.3
Deviation.....	+0.2	0.0	—0.2	—0.4	—0.4	+1.2	+0.4	—1.6	—2.7	—1.6	—0.8	—0.7
Grundkallen.....	1.6	0.4	0.2	0.9	3.2	9.4	14.1	15.1	11.0	7.6	4.6	2.4
Deviation.....	+0.1	—0.3	—0.2	—0.2	0.0	+1.2	—0.2	—0.8	—1.8	—1.1	—1.2	—1.1
Svenska Björn.....	2.7	1.2	0.5	1.3	4.0	9.5	15.1	14.5	11.0	8.2	6.0	3.6
Deviation.....	+0.3	0.0	—0.6	—0.4	—0.2	+0.6	+0.4	—1.3	—2.1	—0.8	—0.6	—0.7
Hävringe.....	3.4	1.5	0.7	1.6	6.5	10.5	14.5	15.3	12.2	8.8	6.0	3.5
Ölandsrev ¹⁾	3.2	2.1	1.7	2.7	5.6	10.3	14.6	15.4	13.2	9.8	7.3	5.1
Falsterborev.....	4.2	2.6	2.4	4.2	8.9	11.8	15.0	16.2	13.0	9.8	7.1	4.2
Deviation.....	+1.3	+0.8	+0.4	+0.5	+1.1	—0.6	—0.8	—0.3	—1.7	—1.9	—1.3	—0.9
Oskarsgrundet.....	3.8	2.2	2.2	4.4	9.6	12.5	15.3	16.2	13.1	9.6	6.2	3.3
Deviation.....	+1.0	+0.3	0.0	+0.1	+1.2	—0.6	—0.8	—0.5	—1.7	—1.8	—1.8	—1.4

¹⁾ 1923—41, 1946—51.

Table 5. The Monthly Mean Bottom Temperature at the Lightships compared with Mean Values.

	Depth, m.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Sydstøbtrotten....	40	3.1	—	—	—	2.0	2.4	2.8	3.3	3.4	4.3	4.2	2.9
1943—52.....	40	—	—	—	—	1.6	2.0	2.4	3.2	3.9	6.1	4.9	3.9
1923—42.....	45	2.8	—	—	—	1.8	2.0	2.3	2.6	3.6	6.2	5.4	4.0
Finngrundet.....	30	1.9	0.9	0.4	0.9	2.7	5.0	5.6	5.5	7.0	6.2	4.1	2.4
1948—52.....	30	1.6	0.6	0.4	1.1	2.8	4.5	5.2	5.3	5.8	6.5	5.1	2.9
1923—43, 45—52	20	1.6	0.9	0.7	1.2	2.9	5.1	7.2	8.4	9.9	7.8	5.2	3.0
Grundkallen.....	40	2.1	0.8	0.4	0.9	2.6	3.6	5.2	4.6	7.8	7.2	4.7	2.8
1948—52.....	40	2.1	1.1	0.4	1.2	2.3	3.9	5.4	5.3	5.8	7.2	5.5	3.7
1923—39, 46—47	50	2.6	1.7	1.4	1.2	2.1	3.3	4.0	5.4	5.8	6.4	5.8	4.0
Svenska Björn...	40	3.6	2.2	1.3	1.0	2.9	3.8	4.0	5.2	6.4	8.0	6.8	4.7
1948—52.....	40	2.7	1.6	1.3	1.2	2.4	3.2	3.8	5.3	5.6	6.3	6.1	4.6
1923—39, 46—52	30	2.7	1.7	1.2	1.4	2.7	4.5	6.0	7.2	8.9	8.0	6.4	4.5
Hävringe.....	40	3.5	1.8	1.0	1.5	3.8	3.6	4.1	5.8	6.7	8.7	6.4	4.7
Ölandsrev ¹⁾	45	3.5	2.5	2.0	2.4	3.8	4.3	4.6	4.6	5.2	6.0	5.5	4.6
1948—51.....	40	3.3	2.6	2.2	2.8	4.5	5.2	6.1	5.6	5.7	6.2	6.6	5.0
Falsterborev.....	10	4.3	2.6	2.4	3.9	8.8	11.2	13.8	15.9	13.0	9.8	7.2	4.1
Deviation.....	—	+1.4	+0.8	+0.4	+0.3	+1.3	—0.6	—0.8	+0.2	—1.6	—1.9	—1.2	—1.0
Oskarsgrundet...	8	4.1	2.4	2.3	4.4	9.1	12.4	15.2	15.9	13.1	9.8	6.9	3.6
Deviation.....	—	+0.7	0.0	—0.2	+0.1	+1.0	—0.1	—0.6	—0.6	—1.7	—1.7	—1.5	—1.1

¹⁾ 1923—41, 1946—1951.

further into the Baltic on this occasion. In January only, the salinity was higher than usual at the "Falsterborev" indicating that the inflow of high salinity water starting in November 1951 had not finished before February 1952. As in 1951 the salinity had increased in June.

The investigation of the hydrographic situation in the deep basins of the central Baltic could be carried out in March and August. The results are given in Table 6. The Gotland Deep shows increasing salinity values at all depths but especially below 150 m., where the salinity was about 1 ‰ higher than in 1951.

Table 6. Hydrographical Measurements in the Deep Basins of the Central Baltic.

West of Gotland			Gotland Deep			Landsort Deep								
57°28'N., 18°06.5' E. 22. March			57°27' N., 17°23' E. 6. August			57°27'N., 20°06' E. 7. August			58°40'N., 18°18' E. 24. March			58°37' N., 18°15' E. 11. August		
m.	°C.	‰ S	m.	°C.	‰ S	°C.	‰ S	m.	°C.	‰ S	m.	°C.	‰ S	
0	1.95	7.66	0	17.20	7.12	16.92	7.21	0	0.82	6.95	0	16.06	7.19	
10	2.27	7.67	5	17.35	7.12	16.89	7.14	10	0.87	6.98	10	16.01	7.21	
20	2.35	7.67	10	16.71	7.12	16.72	7.15	20	1.34	7.12	15	15.88	7.21	
30	2.19	7.68	15	15.65	7.21	16.50	7.17	30	1.87	7.21	20	9.20	7.30	
40	2.18	7.68	20	13.15	7.30	14.61	7.37	40	2.06	7.30	25	5.65	7.39	
50	2.40	7.69	30	5.99	7.36	4.97	7.39	50	2.27	7.31	30	4.39	7.44	
60	2.27	7.68	40	5.17	7.49	4.56	7.57	60	4.18	7.95	40	4.20	7.57	
70	4.43	9.40	50	3.23	7.66	3.64	7.73	70	4.38	9.39	50	3.58	7.67	
80	4.90	10.59	60	4.29	8.84	2.96	8.03	80	4.51	—	60	3.63	8.12	
100	5.38	11.49	80	4.55	10.21	4.52	10.11	100	4.65	10.38	80	4.57	10.29	
125	5.58	12.21	100	4.69	10.49	5.29	11.64	150	4.80	10.57	100	5.02	11.03	
150	5.65	12.59	125	—	—	5.50	12.39	200	4.82	—	125	5.14	11.38	
175	6.32	13.30	150	—	—	5.82	13.00	250	4.92	10.83	150	5.19	11.47	
			175	—	—	6.34	13.56	300	4.95	10.86	200	5.26	11.54	
			200	—	—	6.47	13.89	350	4.86	10.91	250	5.20	11.56	
								415	4.93	10.94	300	5.14	11.56	
											400	5.20	—	
											450	5.23	11.56	

Also the temperature had risen by nearly 1°. At Landsort Deep the rise of salinity was later (observed in August) and amounts only to 0.4 ‰ compared with the preceding year. West of Gotland the rise of salinity was found to be in March 3 ‰ at 170 m. and 1.2 ‰ at 100 m. depth. The remarkably strong inflow of high salinity water during the period November 1951 to January 1952 seems to be

the cause of the new increase of the bottom salinity in the Baltic. The discontinuity layer seems, more or less, to be affected by this renewal of bottom water and rests at about 70 m. throughout the central Baltic. In general, the salinity of the surface has also risen during 1952.

F. KOCZY.

Plankton.

Danish Observations.

The collection of plankton at Christiansø fortnightly was discontinued from June to December. The fat contents, in the samples and in 20 samples taken in August from S/S "Biologen" (see Table 7) show that the mean was somewhat higher than in 1951. This seems to be explained by the fact that the influx into the Baltic of saline water, bringing nutrient salts, was very much stronger during the winter of 1951 than in the winter of 1950.

Table 7. Fat Contents in vertical Plankton Samples in 1952.

	No. of samples	Fat mean	Percentage range
At Christiansø			
February.....	2	9.2	5.9—12.5
April.....	2	14.7	13.5—15.9
May.....	2	32.2	28.8—35.6
June.....	1	35.6	—
December.....	1	31.4	—
South of Scania, Aug.....	7	20.2	11.6—27.8
Round Bornholm, Aug. ...	13	21.7	11.0—29.8

The strong influx is indicated by the monthly mean surface salinities of 14.5, 17.1 and 13.5 ‰ at Drogden, in November, December 1951 and January 1952, respectively, against 11.8, 11.3 and 11.6 ‰ in the corresponding months in 1950-51.

AAGE J. C. JENSEN.

Swedish Observations.

In the summer of 1952 in the Bothnian Sea, investigations on the mortality of *Eurytemora* caused by *Leptolegnia* have been carried out. No such mortality has however been reported.

Some plankton samples from localities in the northern part of the Bothnian Sea have been investigated. Only in the vicinity of the town of Örnsköldsvik have occasional *Eurytemora* infected by the mould been observed.

It has now been proved that the mould belongs to a new species of *Leptolegnia*.

STEN VALLIN.

THE FISH

Danish Observations.

Cod.

The density of the stock was the same as in 1951 or a little greater (see Table 8). South of Scania rather great quantities of the 0-group were found, and round Bornholm the frequency of the I-group was higher than in 1951. Thus the prospects for the cod fishery in the Baltic in the coming years seem, still, to be good.

"Bulldog-noses" were found in about the same percentage of cod as in 1951. The 1950 year-class seems to be affected in about the same degree as the 1949 year-class.

Table 8. Length Distribution of Cod in the Baltic in August 1952.

(1-hour trawl catches partly compared with 1951).

Year	Off Seeland S. of and Møen Scania		Round Bornholm		
	1952	1952	1952	1951	1952
Depth, m.	17—25	30—44	46	71—95	70—98
cm.-group:					
<5.....	—	0.5	4	—	—
6—10.....	6	62	22	0.4	0.6
11—15.....	0.5	4	—	4	19
16—20.....	2	—	—	33	63
21—25.....	6	—	—	58	62
26—30.....	4	2	—	49	56
31—35.....	2	8	—	20	30
36—40.....	2	12	2	12	14
41—45.....	2	10	14	8	6
46—50.....	—	9	2	10	4
51—55.....	2	10	—	4	4
56—60.....	—	4	—	2	1
61—65.....	—	3	—	1	0.6
66—70.....	—	2	4	0.2	—
71—75.....	—	1	2	1	0.2
> 76.....	—	0.5	—	1	—
No. of stat...	4	4	1	9	10
Mean number per hour....	27	128	50	204	260

Flatfish.

0-group.

The density of the 0-group of plaice and flounder was investigated with the Johansen young-plaice-trawl on the Seeland-Møen coasts of the Baltic area, and the results are as follows: —

Number of stations	Plaice	Flounder
6	9 (5)	0 (364)

Means for 1928-1951 are given in brackets. It will be seen that the number of 0-group

plaice was double the normal but no 0-group flounder was caught. The figures from the investigation at Bornholm, where the hand push-net was used, are not available as yet, but here also the number of 0-group plaice was higher than normal whereas that of the flounder was lower than normal.

Older age-groups.

The density, length and age of the older age-groups was investigated with the trawl (see Table 9).

Table 9. Number of the various Age-Groups of Plaice, Flounder and Dab caught per hour with trawl from S/S "Biologen" in August 1952.

	At Stevns-Møen	S. of Scania	Round Bornholm
Plaice			
II-group.....	7	1	—
III-group.....	0.5	—	—
IV-group.....	—	—	0.2
Flounder			
II-group.....	0.5	—	1
III-group.....	2	—	2
IV-group.....	—	—	0.4
Dab			
I-group.....	20	0.5	—
II-group.....	10	2	0.6
III-group.....	0.5	0.5	0.4

As usual the densities of the stocks were very small. The 1950 year-class of plaice which was the best represented as II-group in the eastern parts of the Baltic area has been found in 1950 as 0-group in small numbers both at the Seeland-Møen coast and at Bornholm (see Ann. Biol. VII, p. 115) but in quantities above the normal in the Sound and in the western Baltic. This might seem to indicate an immigration to the region from the Sound or the Belt Sea.

AAGE J. C. JENSEN

Swedish Observations.

Salmon.

The diagram in Figure 2 gives a summary of the Swedish salmon catches in the Baltic and the Baltic rivers for the last thirteen years.

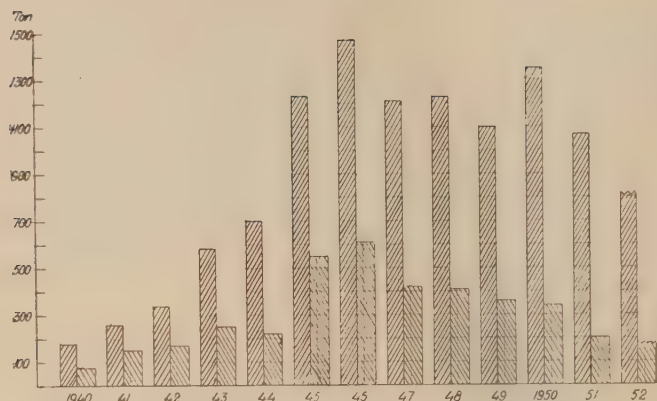
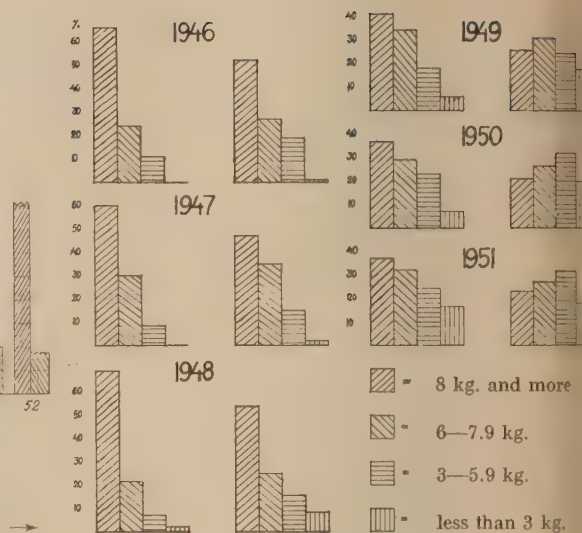


Figure 2. The Swedish catch of salmon in the Baltic and its rivers in tons.

Figure 3. The distribution of the catch in percentage on different sizes: weight in kg. (left) and numbers (right) Gotland.



From the figures it will be seen that the yield of the salmon fisheries increased up to 1946, that it was then at its highest level and since has shown several fluctuations, but has slowly decreased. The catches in the rivers have been about $\frac{1}{2}$ or $\frac{1}{3}$ of the catches in the sea, and this correlation seems to be about the same in both rich and poor years. However, the decrease in the river catches is evidently a little bigger than in the sea catches.

The employment for the first time in the years 1948 and 1949 of drift lines with snoods of nylon and very small hooks has caused an increasing catch of smaller and younger salmon, as will be seen from the diagram in Figure 3. In the years 1946-48 mostly very big salmon were caught. Age investigations have shown that the main age-groups in the season 1947-48 were the 6- and 7-year-olds being about 45 and 30 % respectively. Normally the

chief ages of the sea-caught salmon are 5 and 6 years comprising about 45 and 35 % respectively. The high preponderance of big salmon in the years 1946-48 may perhaps partly depend on the fact that in the later war years 1944-45 salmon fishing of only very little importance was carried on in the southern Baltic. The young salmon thus got an opportunity of growing up before they were caught in the first years after the war. In the year 1949 the percentage of big salmon was much smaller and in the following years, 1950-51, salmon with a weight of below 3 kg. and 3-6 kg. were caught on a large scale. Of course, it would be advisable to try to limit this fishing of very small salmon, either by avoiding using small hooks or by forbidding salmon fishing with drift-lines in the months of December and January, in which the smallest salmon are generally caught.

GUNNAR ALM

Herring.

INTRODUCTION

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Mr. B. B. PARRISH Mr. A. SAVILLE

The papers give a good idea of the problems, that have occupied the herring scientists in all countries. Most of them make considerable effort to study the stocks, their size, fluctuations and behaviour, which is of course a matter of the most outstanding importance. But new promising lines of research have also been introduced.

Only five years have passed since the first marking experiments on herring were made in Norway and Iceland (1948). Since then a number of countries have introduced marking as one of the most effective methods in herring research. Some of them have spent a great deal of time and money on the experiments, especially Denmark, Iceland, Norway, Scotland and Sweden. Also Belgium, England and France are now participating, and the number of herring already tagged is somewhere near 200,000 (at present). Through the tagging we have been able to achieve a lot of new knowledge on the migrations of the herring, on relations between populations, and, if we continue with the same speed, many years

will not pass before we can estimate the effect of fishing on the stocks.

Another line of research concentrates upon practical herring investigations in close connexion with the fisheries, simultaneously carried out and for the immediate benefit to them. This kind of work appears clearly in the paper of Mr. FINN DEVOLD. In most countries experiments with echo-sounders have been carried out and in one case (Norway) the asdic has been operated for some years with great success. It is hardly a problem any longer to locate herring by means of the modern instruments now in use. The general plan of applied herring investigations is:— 1) The location of herring shoals (mostly submarine) by means of sounders, asdic and hydrographical observations, 2) Collection of data relating to the relation between the density of fish and hydrographical conditions, due regard being taken to the physiological status of the herring.

It is finally worth noting that increasing international collaboration is in progress in the field of herring research. The Scandinavian countries, especially Denmark, Iceland and Norway have now been co-operating for some years, and in May and June last year (1952) they succeeded for the first time in investigating almost simultaneously the vast area from the Faroes to Bear Island, from the coast of Norway to the ice-border, in search of herring and favourable conditions for herring. When the trips, which were carried out by "Dana" (Denmark), "G. O. Sars" (Norway) and "María Júlía" (Iceland) had been completed, the scientists met on Seyðisfjörður, E.-Iceland, in order to compile the material for a general survey and make their conclusions. The cruises will be repeated this year with the assistance of more countries, especially Scotland, and it is hoped that they will be a fixed point on the research programme in the years to come. — A similar co-operation is now being introduced between the countries bordering the southern North Sea, particularly for the research on young herring. It is hoped that this new teamwork will be continued and even extended to cover all the North Sea area.

ARNI FRÍÐRIKSSON

REPORTS

A. Atlantic Waters.

COMMERCIAL FISH

Iceland.

The Icelandic North Coast Herring in 1952.

It has been mentioned in the earlier issues of Ann. Biol. that the yield of the herring fishery off the north coast of Iceland has been decreasing since 1945, which was the first really poor year. In 1952 the catches were still poorer than in any previous year. There were 176 decked fishing vessels in operation, including 11 modern trawlers. The gears used were purse-seines and ring-seines and the total herring catch amounted to 98,572 hectolitres only. 41,125 hectolitres were processed to oil and meal.



Figure 1. North coast herring 1952. Localities of sampling.

During July-August 1949 herrings were examined in Siglufjörður for length, sex, stages of maturity, intestinal fat, number of vertebrae (VS), age and growth-type. In most cases the herring was also weighed and the weight of the gonads was recorded in order to check the stage of maturity (maturity factor, MF).

The origin of the samples is shown on the chart in Figure 1. The fishing took place, almost entirely, in far offshore waters, as in the previous season (1951), partly in the open ocean east of Iceland. The map does not give a correct idea of the location of the main fishing grounds as material from the eastern part of the area was hard to obtain in Siglufjörður. The herring caught east of Iceland were processed in the factories on the north-east and east coasts and we got only a single sample from there, (see the chart).

Taken as a whole the material proved to be rather homogeneous when racial characters,

Table 1. Size of North Coast Herring in 1952.

Length cm.	Percentages.		Total
	Samples 1-15, 17 & 19	Samples 16 & 18	
39	0.4	—	0.4
38	2.3	—	2.1
37	18.5	—	16.5
36	41.8	3.0	37.7
35	28.9	4.0	26.2
34	7.2	15.0	8.0
33	0.6	17.0	2.4
32	0.3	13.5	1.7
31	—	21.0	2.2
30	—	15.0	1.6
29	—	6.0	0.6
28	—	5.5	0.6
Total	100.0	100.0	100.0
Number	1695	200	1895 ¹⁾
Mean	35.77	31.80	35.36

¹⁾ 74 trawl-caught herring from the western part of the coast (June) are omitted.

age composition and the stage of maturity were considered, except for two samples (16 and 18) from coastal waters off the east coast. The main stock was evidently Norwegian and the exceptional samples were of Icelandic origin, being mostly summer spawners.

The size of the herring is shown in Table 1 and in Figure 2. The average length of all samples together was 35.36 cm. or 0.16 cm. higher than in the preceding year. On the

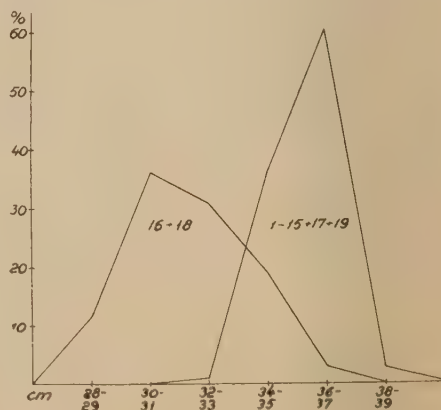


Figure 2. Diagram showing the size composition of the main stock of north coast herring in 1952 (right) and of those in the two exceptional samples Nos. 16 and 18 (left).

Table 2. Age of North Coast Herring in 1952:

		Percentages.					
Age	Year-class	NN	NS	ISPR	ISUM	%)	Total
3.....	1949	—	—	11.2	3.0	—	1.4
4.....	1948	—	—	10.6	29.6	—	3.4
5.....	1947	0.1	—	5.3	18.5	—	2.1
6.....	1946	0.1	—	12.9	11.1	—	2.3
7.....	1945	0.7	1.8	21.8	23.0	—	4.7
8.....	1944	1.7	5.5	8.2	3.7 (26.6)	—	3.3
9.....	1943	2.3	12.4	5.3	2.2 (6.7)	—	4.3
10.....	1942	1.4	10.5	6.5	1.5 (13.3)	—	3.6
11.....	1941	3.2	11.6	1.8	3.0 (20.0)	—	4.6
12.....	1940	5.0	13.9	13.5	3.7 (13.3)	—	7.3
13.....	1939	7.8	7.6	2.3	0.7 (6.7)	—	6.8
14.....	1938	13.9	9.8	—	—	—	13.8
15.....	1937	25.3	7.6	—	— (6.7)	—	17.5
16.....	1936	8.9	5.5	—	—	—	6.6
17.....	1935	9.0	4.3	0.6	—	—	6.5
18.....	1934	13.3	7.3	—	—	—	9.9
19.....	1933	2.0	1.5	—	—	—	1.5
20.....	1932	0.3	0.7	—	— (6.7)	—	0.4
Total.....		100.0	100.0	100.0	100.0 (100.0)	—	100.0
Number..		1086	275	170	135	15	1681
%).....		121	8	1	16	142	288
Grand Total		1207	283	171	151	157	1969
%.....		66.6	15.6	9.4	8.4	—	100.0

1) Scales not fit for determination of type.

2) Scales not fit for age reading.

other hand, the average size of the stock proper, proved to be 35.77 cm. or nearly 3 mm. more than in 1951, and the highest average size ever recorded. This shows, that the trend towards larger fish, which has been noted during recent years, is still in progress. The great difference in average size and size distribution of the herring in the bulk of the stock on the one hand and in the samples Nos. 16 and 18 on the other, is quite clear. The Atlanto-Scandian herring is much larger (and older) than the Icelandic one.

In Table 2 a survey is given of the age of the herring. All the material has been divided into the usual four types: 1) Northern Norway (NN), 2) Southern Norway (NS), 3) Icelandic spring spawners (ISPR) and 4) Icelandic summer spawners (ISUM). The age composition in each type (tribe) and the relative abundance of the tribes is also shown by the diagram in Figure 3.

The age distribution in the stock as a whole ranged from 3 to 20 years, representing 18 year-classes (1932—1949) 5 of which were more or less predominating. The principal dominant was the 15-year-old fish (1937) closely followed by the 14-year-old ones (1938). It is however of special interest to consider the strength of the year-classes in the

different "types" as shown in the table and on the diagram. In the northern tribe there are four predominating year-classes, exactly as last year, the strongest one being the 1937 class forming more than 25 % of this, most important, part of the stock. The same dominants are met with in the southern Norwegian tribe (NS), where the brood from 1940 is also predominating. As a whole the herring in this tribe is younger than in the northern one. The youngest (relatively) dominating year-class (1943) is only slightly represented in the northern tribe (2.3 %) but seems to be of considerable value in the southern one (12.4 %).

The age composition of the two Icelandic tribes is altogether different, except that the

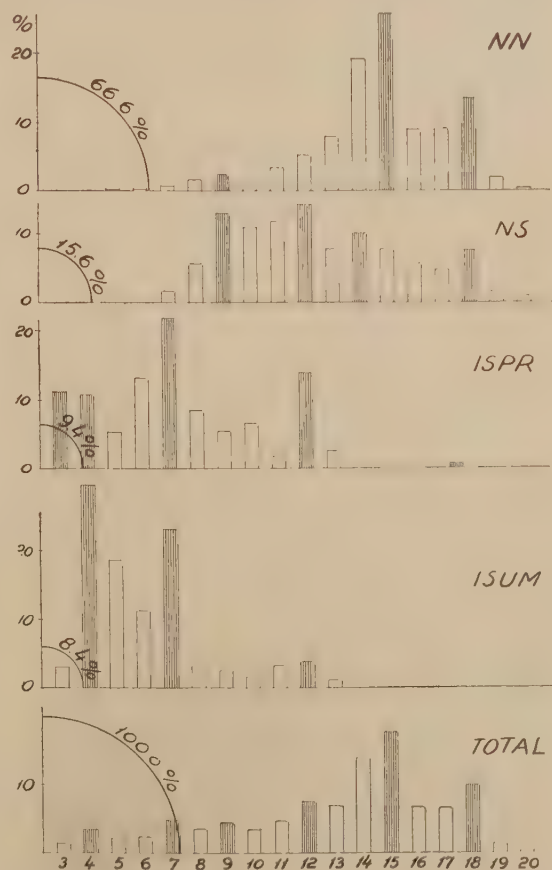


Figure 3. North coast herring 1952. Age distribution of the different tribes and the relative number of fish in each tribe (circles at left). NN = North Norway type; NS = South Norway type; ISPR = Icelandic Spring Spawners; ISUM = Icelandic Summer Spawners.

12-year-old fish (1940) are important in the spring spawning stock (ISPR) and show a trend to relative predominance in the summer spawning one too (ISUM, 3.7 %). The 7-year-old fish (1945) were most predominant in both tribes and besides that, there were a great number of 4-year-olds (1948) in the summer spawning stock.

There is no doubt, that the complete failure of the fishery on the banks off the north coast was due to the absence of the main stock (NN and NS), which however is very rich. But still the northern Norway type yielded about two thirds of the total catches (66.6 %) by number and certainly much more by weight. As can be seen from the bottom of Table 2 and from the diagram, the Atlanto-Scandian herring contributed by 82.2 % of the total yield. The migration of herring from the south and south-west coast must consequently have been on a very small scale, as usual.

Table 3. The Total Number of Vertebrae (VS) in the different Tribes of the North Coast Herring 1952.

VS	NN	NS	ISPR	ISUM	?	Total
59	18	5	1	—	3	27
58	319	66	49	16	39	489
57	729	170	96	103	89	1187
56	139	40	25	31	25	260
55	3	1	1	1	—	6
N	1208	282	172	151	156	1969
M	57.17	57.12	57.14	56.89	57.13	57.13
± m	0.018	0.035	0.032	0.048	0.049	0.015

The number of vertebrae is shown in Table 3, where a survey is given for each tribe separately. The average number is slightly higher than last year now being 57.13 %. The summer spawners are clearly distinguished from the remainder of the stock through a lower number of vertebrae, but the other components cannot be separated by that means. It is especially interesting to note, that the Icelandic spring spawners (ISPR) did not differ from the Atlanto-Scandian stock, being very similar to the NS-type with regard to the number of vertebrae. The relatively high number of vertebrae in the "uncertain" (?) herring suggests that the major part of it was of spring spawners.

It is of interest to compare the number of vertebrae and the stages of maturity as in Table 4. The table shows very clearly the

Table 4. Total Number of Vertebrae according to the Stages of Maturity.

(Trawl-caught herring omitted).

Maturity Stages	Samples 1—15, 17 & 19 Number	VS	Samples 16 & 18 Number	VS
II.....	1	57.00	34	57.00
III.....	502	57.18	13	57.08
IV.....	3	56.67	—	—
V.....	—	—	—	—
VI.....	—	—	—	—
VII.....	3	56.67	97	56.89
VIII.....	1186	57.16	56	56.95
Total.....	1695	57.16	200	56.93

difference between the herring in the main stock and those in samples 16 and 18. In the first case we are almost entirely dealing with spring spawners as the difference in the number of VS between III and VIII is by no means significant. The reverse is the case with samples 16 and 18, which are mostly comprising summer spawners.

The relative weight of the gonads was calculated as percentages of the total weight of the herring for 1948 fish (maturity factor). The average values of the maturity factor (MF) proved to be as follows:—

Stage:	MF (%)
VII.....	1.13
VIII.....	1.68
III.....	3.00
IV.....	16.60
V.....	21.00

In Figure 4 the herring have been divided into groups according to the value of MF (0—1 %, 1.1—2 % etc.) and the numbers of herring in each group are given as far as the maturity stages VII, VIII and III are concerned. The stage of maturity was determined in the

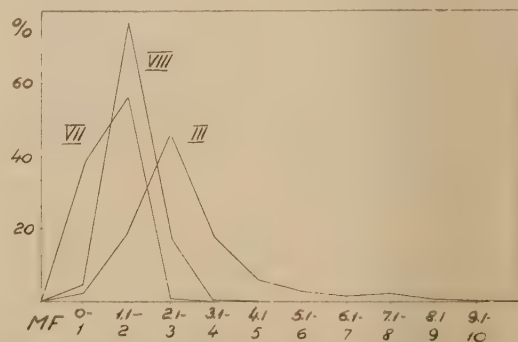


Figure 4. Range of Maturity Factor (MF) in correlation to maturity stages VII, VIII and III.

usual manner and the MF-value found by weighing. There is evidently too much overlapping to allow a discrimination between VII, VIII and III, which identification is often based more on the appearance of the gonads than their relative weight. The MF-value of 1.1—2 can for instance indicate any of the three above-mentioned stages.

As mentioned in the Administrative Report, a motor-boat was chartered to tag herring by the internal method which had been used earlier. Altogether 17,308 fish were tagged and none of the tags was returned during the season. In good agreement with the poor catches only 5 tags from previous experiments are on record:—

Iceland	1950	1
—	1951	3
Norway	1952	1

It is, however, doubtful whether 2 of the tags from 1951 really came from fish caught in 1952 or if they originated from a late catch in the previous year. The tag that came from Norway is particularly interesting because it indicates the usual migration from Norway to Iceland in spite of the poor catches.

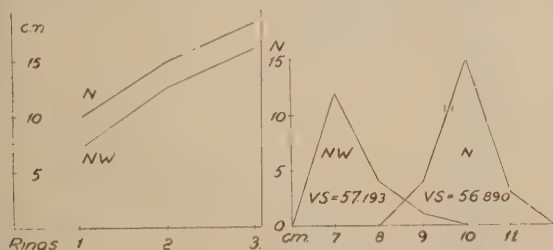


Figure 5. Young Herring from the Hröfðskær (N) and Ísafjörð-deep (NW). Left: the growth until the third winter ring is formed. Right: average number of vertebrae and the size composition when the first ring was formed.

A large number of small herring occurred during the summer on different parts of the coast. Some of them were caught for bait or canning. Two samples were examined, one being from the Ísafjörð deep on the NW. coast (133 fish) and the other from the entrance of Eyjafjörð on the N. coast (225). The age ranged between 1 and 3 years and one of the samples consisted entirely of summer spawners (north), the other of spring spawners (north-west). In Figure 5 the main features of interest are demonstrated, showing the growth rate, which was calculated by scale measurements, the number of Vert. S and the size and size range at the time when the first winter-ring in the scale had been formed.

ARNI FRÍÐRIKSSON

North and North-East of the Faroe Islands.

Occurrence of Herring.

The area north of the Faroes, in which Danish investigations on the occurrence of oceanic herring have been carried out since 1948, was operated by various vessels during 1952.

R/S "Dana" carried out work during the month of June and made sections over the East Icelandic Arctic Current and adjacent currents from 1° W. Long. to the east coast of Iceland and from the Faroes to 65°30'N. Lat. Herring was located around "the cold tongue" of the East Icelandic Arctic Current, especially to the east of the current (temperatures in 20 m. depth 6°—7°C.).

The research cutter "Jens Væver" assisted in these investigations during the month of May; herring were located in the same area as in previous years, closest to the Faroes at about 60 nautical miles NE. of Enniberg. Herring floating trawl was operated a few times in the beginning of June in collaboration with a Faroe cutter with some catches (up to 800 kg. per hr.); owing to the light nights at this time of the year great catches cannot be expected with this gear.

Also, the inspection vessel "Thetis" carried out investigations on the occurrence of herring, using both asdic and echo-sounder. This work was carried out in the area in March, July and November; in March the herring had not yet arrived; in July many herring were present and also in November (about 100 naut. miles off the Faroes at 4°—5°C.). All observations by "Dana", "Jens Væver" and "Thetis" were reported to Faroe fishermen.

Å. VEDEL TÅNING

Norwegian Sea.

The age composition in the samples of the Norwegian winter herring from the years 1948 to 1952 is shown in Figure 6. The material is divided by the areas where the samples have been caught. The large herring are caught in the districts north of Bergen, mainly during the first months after the arrival of the herring in Norwegian coastal waters. The spring herring are caught in the districts south of Bergen during the spawning season proper. The age composition shows:—

1. A strong year-class in the spring herring is represented as a strong year-class also in the large herring, and the weak year-

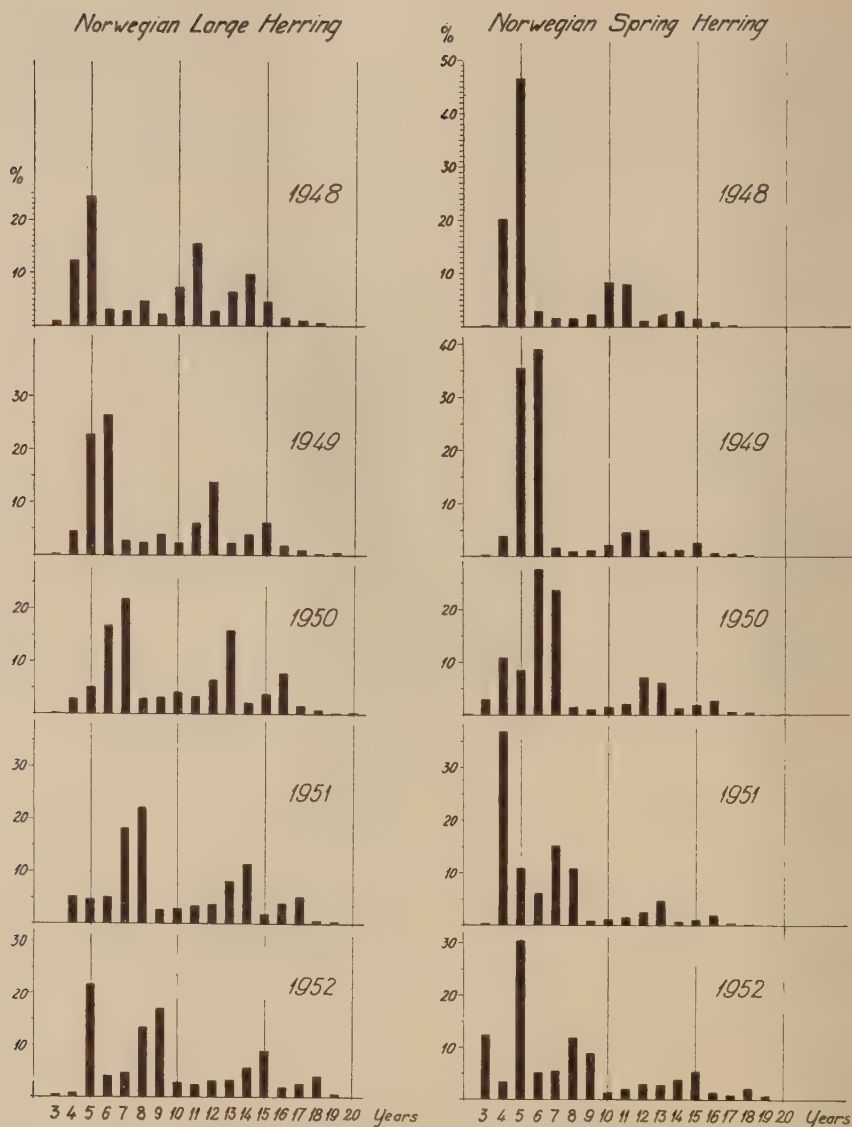


Figure 6. Age composition of samples.

classes turn out to be weak ones in the samples from both areas.

2. The young herring dominate in the samples of the spring herring to a much greater extent than they do in the large herring samples.

These two points must be regarded as facts, as they occur in all years from which we have samples from the two areas. Examinations of the scales of the herring from the two areas

show no difference in growth. The marking experiments carried out since 1948 by O. AASEN and Å. FRIDRIKSSON leave no doubt as to the connexion between the spring and the large herring. In other words, these are facts which seem to support LEA's theory that the spring herring and the large herring belong to the same tribe.

RUNNSTRØM, TH. RASMUSSEN and SUND have shown that the number of vertebrae of the

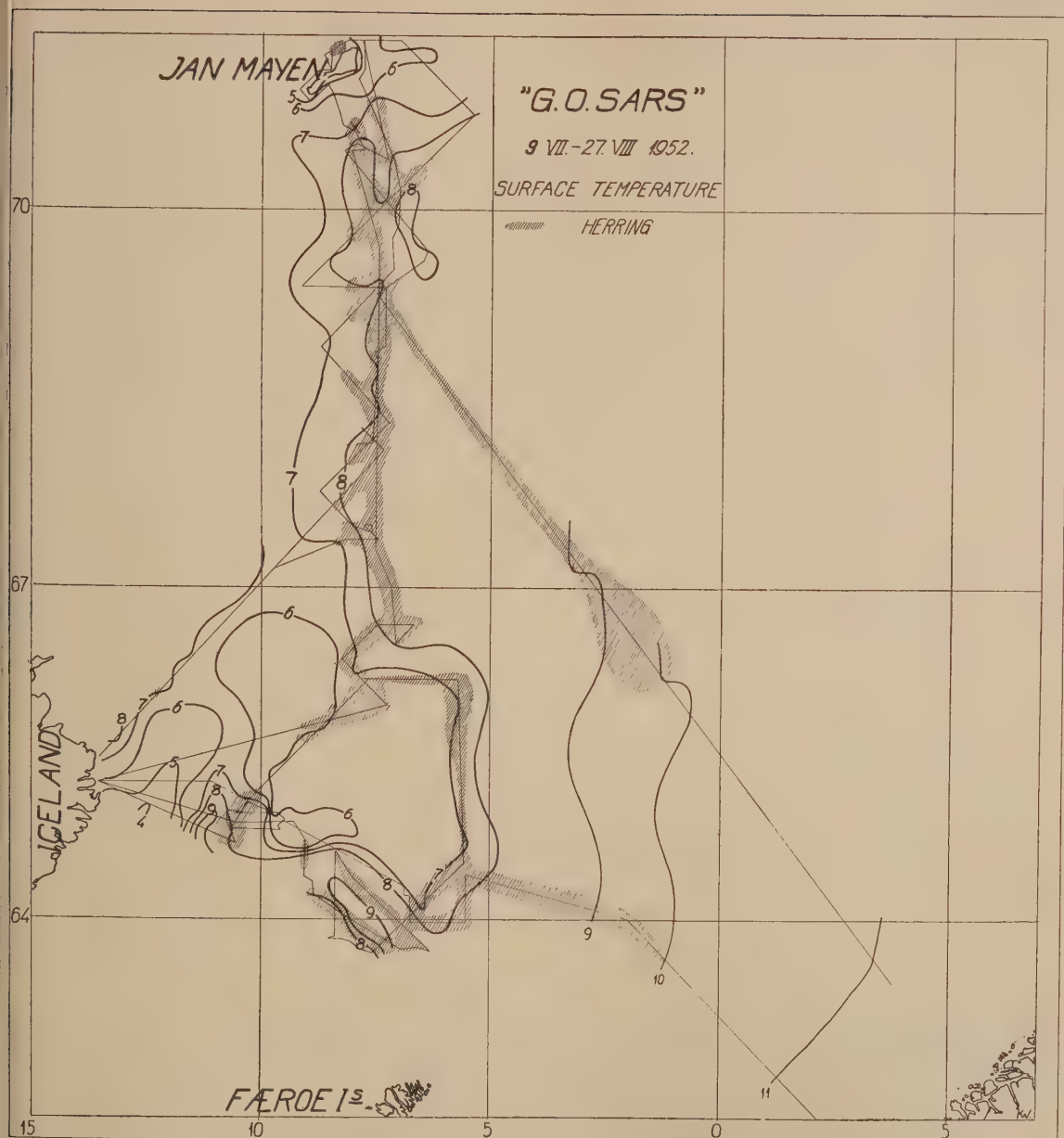


Figure 7. Route of "G. O. Sars" in July and August 1952.

spring herring differs from that of the large herring. From this difference RUNNSTRØM draws the conclusion that the Norwegian winter herring must be divided at least in two different tribes, and he suggests that the large herring leave the Norwegian coastal waters after a short visit, the Viking Bank being their main spawning ground. It is a fact that herring

showing the same morphological characters as the Norwegian herring do spawn on the Viking Bank, and it is difficult to explain the difference in vertebrae between the spring herring and the large herring. The different age compositions shown in Figure 6 can be explained as an effect of the first time spawners arriving later than the older herring at the

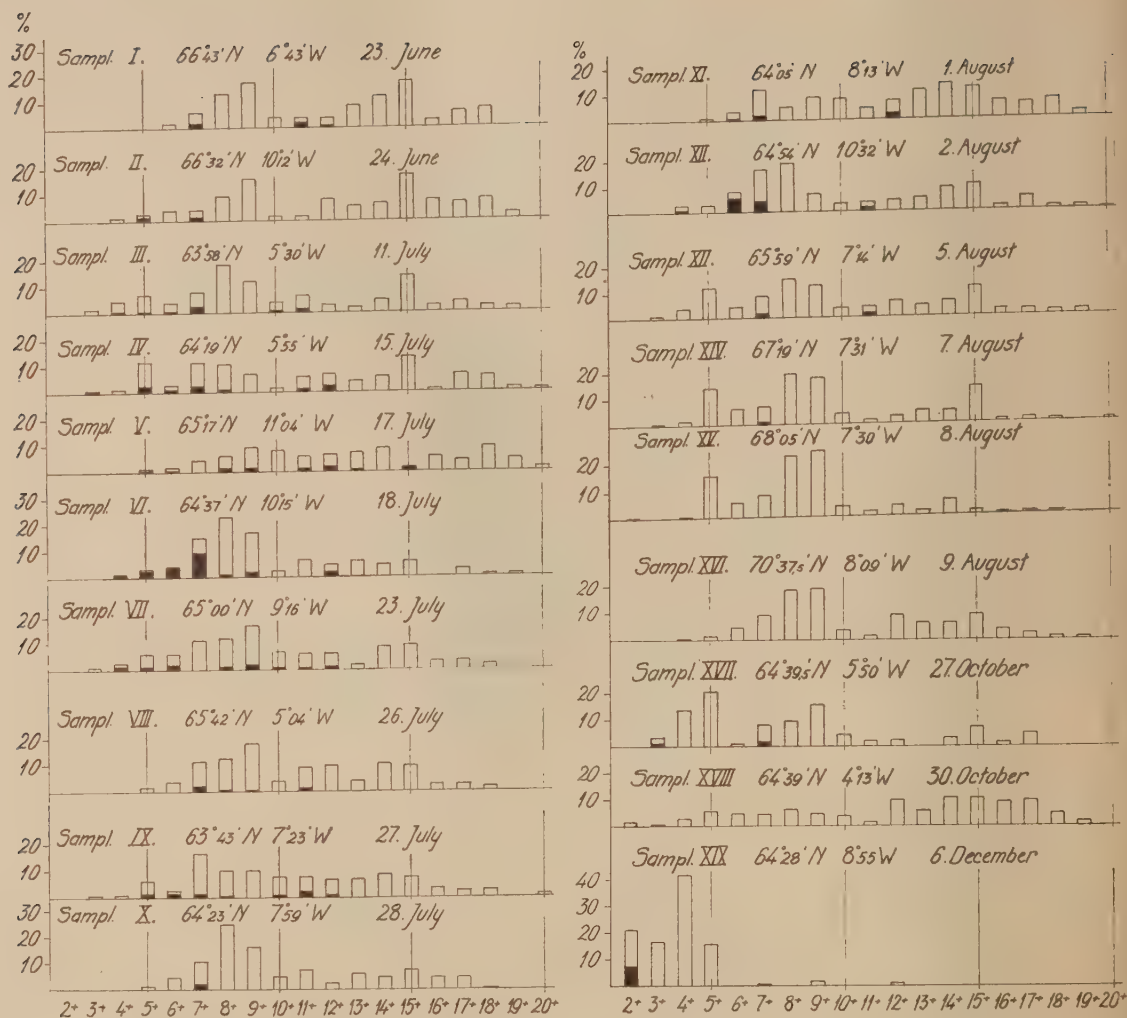


Figure 8. Age composition of samples from the open sea.

Norwegian coast, and therefore appearing in full strength only in the spring herring districts, where the fishing is carried out in the last part of the season. This explanation, however, is not convincing. In the last few years, the herring fishery has been carried out in the large herring districts after the spring herring fishery has started. The young herring dominate the spring herring samples, at the same time as we still have the older year-classes dominating in the large herring samples.

I am afraid we have to carry out investigations in another field in order to settle the question. The last three winters we have succeeded with the "G. O. Sars" in locating and following the large herring on their migra-

tion to the Norwegian coast. The shoals follow the East Icelandic Arctic Current as far as it extends towards the Norwegian coast, and they penetrate the Gulf Stream off the coast of More. The East Icelandic Arctic Current also sends a branch of cold water southwards, east of the Faroe Islands. In the winter 1950/51 we discovered great concentrations of herring also in this branch, but lack of time prevented us in trying to trace their further movements. If the herring gathering in this branch penetrate the Gulf Stream to the Shetland Banks, Viking Bank, at last to arrive in the spring herring district, it would be easier to explain the complications that confront us; but further investigations are necessary to examine this suggestion.

Figure 7 shows the route of the "G. O. Sars" in July and August 1952. The isotherms are drawn from thermograph recordings taken at a depth of 4 m. The hatched areas indicate the positions in which herring have been located by use of asdic and echo soundings. It will be seen that the herring are found mainly at the frontier of the East Icelandic Arctic Current, where the temperatures are between 7 and 9°C.

In the autumn and early winter the "G. O. Sars" was engaged in three cruises in the area north of the Faroe Islands, where extensive hydrographical observations were collected. Also, during this winter, the herring were located in the cold water of the East Icelandic Arctic Current. In spite of very bad weather conditions we succeeded in following the herring shoals on their migration to the Møre coast, and information was supplied to the fishing fleet about the approach of the herring towards the coast.

Figure 8 gives the age composition of the herring samples secured during cruises in the open sea. The open columns denote the herring belonging to the Norwegian tribe, and the black part of the columns shows herring belonging to other tribes according to analysis by TH. RASMUSSEN.

FINN DEVOLD

Tagging Experiments.

The herring tagging work in Norway has been continued during 1952 and extended to comprise also fat herring in northern Norway. The number tagged will be found in the Table 5 and totals 30,824 herrings, bringing the number tagged by the Icelanders and Norwegians up to 118,295 since 1948.

On the tagging cruise in the large herring district only internal steel tags were used. The number tagged was 10,295 herrings. For insertion of the tags (both on this cruise and the following) a "tagging gun" was used (FRIDRIKSSON & AASEN, 1952¹). On the next cruise in the spring herring district, 10,863 herrings were tagged with internal tags only, 898 herrings with both internal steel tag and the Lea hydrostatic tag, and 397 herring with external tag only (the Lea tag). The taggings in the fat herring district were executed from Trondheimsfjord to Lofoten and, in all, 8371 herrings were tagged, of these 7971 internally and 400 extern-

Table 5. The 1952 Recoveries in Norway from the different Taggings.

Tagging Area		Tagged Year	Nos.	Type of Tag	Rec. 1952	% lib.
Norway.....	A	1948	6018	Internal	25	0.42
Iceland.....	B	1948	7475	—	9	0.12
Norway.....	A	1949	8261	—	28	0.34
Norway.....	C	1950	9085	—	16	0.18
Norway.....	A	1950	11215	—	12	0.11
Norwegian Sea.	D	1950	506	—	2	0.40
Iceland.....	B	1950	1321	—	14	1.06
Norway.....	C	1951	10241	—	24	0.23
Norway.....	A	1951	9986	—	73	0.73
			355	Int. & ext.	0	0.00
			644	External	0	0.00
Norwegian Sea.	D	1951	2012	Internal	28	1.39
Iceland.....	B	1951	3064	—	29	0.95
Norway.....	C	1952	10295	—	60	0.58
Norway.....	A	1952	10863	—	16	0.15
			898	Int. & ext.	30	3.34
			397	External	6	1.51
Norway.....	E	1952	7971	Internal	105	1.32
			400	External	31	7.75
Iceland.....	B	1952	17308	Internal	0	0.00
		1948-				
Total.....	A-E	1952	118295	Int. & ext.	508	0.43
A = Spring herring				C = Large herring		
B = North coast herring				D = Oceanic herring		
				E = Fat herring		

ally. The types of tags were the same as in the two preceding cruises.

A report on the taggings and the results was prepared in collaboration with Iceland (FRIDRIKSSON & AASEN, loc. cit.) in the summer of 1952. The reader is referred to that paper for details concerning the taggings and the recoveries. In the Table 5, a survey of the returns from the different taggings will be found. It is seen that the total amounts to 508 tags recovered in 1952, this being 0.43 % of the liberated numbers. It must be borne in mind, however, that many of these herrings have spent up to 5 years in the sea since tagging. The number of tagged herring present is therefore substantially reduced. Also, the extensive latest tagging in Iceland was executed after the close of the winter herring fishery in Norway and consequently could not possibly contribute any returns.

The recoveries from the spring herring district in 1952 have been only partly treated in the above-mentioned paper owing to the report being prepared so early in the year, and the fat herring taggings are only mentioned for the same reason. Now, the results from these two last cruises are particularly interesting on account of the new light they throw upon the migrations of the herring, and it is found

¹) FRIDRIKSSON, ÁRNI and AASEN, OLAV, 1951: "The Norwegian-Icelandic Herring Tagging Experiments". Rep. No. 2, Atvinnudeild, Háskólans, Rit Fiskideild, Reykjavík, 1952.

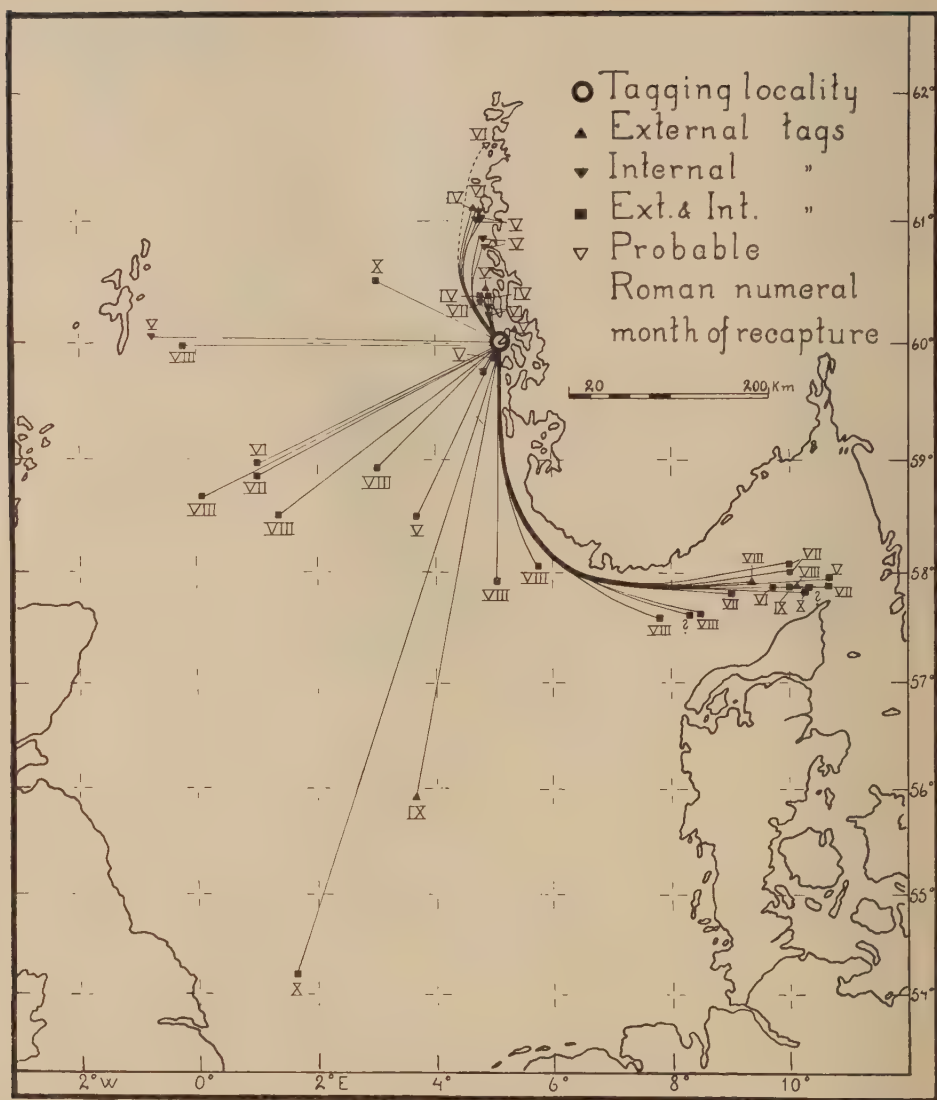


Figure 9. Recoveries in 1952 of spring herring tagged from 31. March to 19. April 1952.

desirable to deal with these results in more detail.

In Figure 9 is presented the distribution of the recoveries in 1952 of the spring herring tagged that same year. Roman numerals indicate the month of return. One will notice a gradual spreading in the North Sea—Skagerrak area with time, but it is also worth noticing that already, in one month's time after tagging (V), the main migration routes are indicated: Northwards along the Norwegian coast, westwards towards Shetland waters, south-

wards towards the North Sea proper, and finally into the Skagerrak. The relatively high percentage of recaptures indicates that the North Sea area and the Skagerrak are being rather heavily fished, and it also goes to show that quite a substantial part of the Norwegian spring herring migrate into these areas outside the spawning season (at least, this was the case in 1952).

In Figure 10 the recoveries in 1952 of the fat herring tagged in the summer of that year are shown. Black circles indicate the tagging

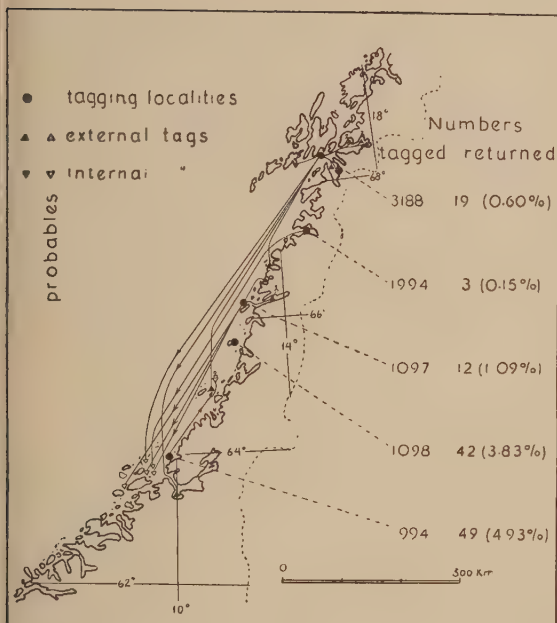


Figure 10. Recoveries in 1952 of fat herring tagged from 13. August to 7. September 1952.

places. On the figure are also entered the numbers tagged and the recoveries. It will be noticed that there is a general trend towards higher recapture percentages on the more southern tagging localities. This may be partly due to the fact that the cruise started in the south and the herring from the more southerly taggings have been exposed to fishery for a longer period of time during the season. The most striking feature of this map is the southwards migration of the herring. In nearly all instances when longer migrations have been observed, the herrings have moved southwards. The longest migration covers, at the least, 360 nautical miles in less than 3 months' time (80 days) averaging 4.5 naut. miles in 24 hours. One practical conclusion may be drawn from the results of this last tagging cruise. For some time the rate of fishing of the younger age-groups of the herring has been discussed amongst the fishermen and also within the fishery administration. There have been voices raised against fishing the small herring altogether so as to allow it to grow to a larger size before fishing. This opinion is caused by the fear of insufficient recruitment to the stock of fat herring and to the stock of adult fish which forms the basis of the winter herring fishery. This fear is revived through the failure

of the spring herring fishery in recent years. Plans have been discussed to close certain fjords to the fishery in order to study the effects. In view of the evidence furnished by the fat herring taggings, this seems to be a doubtful proposition. On the other hand, the relatively high percentage of recoveries seems to indicate that the young herring in Norwegian waters is rather heavily fished.

Special Investigations.

A. The Lusterfjord herring.

Fiskeridirektoratets Havforskningsinstitutt started in 1949 a series of investigations on a local herring "race" in the Lusterfjord¹⁾, one of the tributaries to the Sognefjord. Since then, collecting of samples from this herring has been carried out all the year round, and annual cruises to the area have been made. In 1952, 2634 herrings have been sampled.

The main characteristics of the Lusterfjord herring are its short life cycle, slow growth rate, low vertebral number, and small size of the fully grown animal: —

The age of the sexually mature specimens ranges from 2 to 10 years.

The mean vertebral number is 56.25 (± 0.05). The year-classes show no significant differences between their mean vertebral numbers.

The mean length and the mean weight are 20.86 cm. (± 0.05) and 66.52 g. (± 0.55) respectively.

The herring grows very slowly after 4—5 years, at which age it appears in maximum strength in the shoals of adult fish. Thus the mean length of 4-year-old herring is 19.56 cm. (± 0.08) while the same value for the 8-year-old fish is 21.17 cm. (± 0.29). The growth may be approximately described by the formula: —

$$L_n = (31.92 - 1.21 n) \log (n+1)$$

The maturity cycle is established for the Lusterfjord herring using the description of the stages applied to the winter herring. The approximate durations of the different stages may be given as (mean values): —

Maturity stage	VII	VIII	III	IV	V	VI
Time in months	1	1	5	1	1	3

The maturity cycle has been more closely considered. The weight of the gonads expressed

¹⁾ AASEN, OLAV 1952: "The Lusterfjord Herring". Rep. Norw. Fish. and Mar. Invest., Vol. X. No. 2.

as per cent. of the body weight (M_F) is found to vary, in the maturing period, approximately after the formula (mean values): —

$$M_F = 1.385^t$$

where t is the time in months. For the spawning the formula: —

$$M_F = 1 + 20(1-2^t)$$

applies, the co-ordinate system being the same as for the formula above with origin in the month of the year (June) when the spawning is finished and the building up period begins. The spawning takes place in March—May, mainly in April. The connexion between the maturity stages and M_F is expressed by the formula: —

$$M_F = (0.084x + 1.25)^x$$

where x is the maturity stages VII, VIII, III, IV, and V numbered from 1 to 5. In accordance with this formula, the following limits of M_F for the different stages are proposed:—

		2.0	3.3	6.0	13.1
VII ↓	VIII	III	IV	V	
1.9	3.2	5.9	13.0	↓	

These values agree reasonably well with corresponding figures found by FARRAN & BOWMAN and ERDMANN (according to SCHNAKENBECK).

The intestinal fat has been investigated. Broadly speaking the herring is fat in the summer time and lean in the winter as was well enough known beforehand. The building up of the intestinal fat reserves goes much quicker than the breaking down of the accumulated stores. Maximum of intestinal fat is found in July, minimum in February-April. The amount of intestinal fat and the M_F appear to be negatively correlated.

The condition factor has been considered. The quantity appears to be mainly influenced by the variations in the fat content in the summer months and by the variations in the maturity factor at other times of the year.

The bottom topography of the Lusterfjord has been examined and the results have been charted. It appears that the herring has (physically) completely free access to the open ocean. The herring spawn mainly at Ottum in the innermost part of the fjord, the bottom there being rocky with large stones, but herring eggs have been found also on clay bottom.

The hydrography of the Lusterfjord has been investigated for temperature, salinity, and

oxygen content. The herring spawn mainly between 5 and 15 m. depth. This water-layer at the spawning time is characterized by 5—7°C., 31—33 S ‰, and approximately 8 cm³/litre O₂.

The fauna of the Lusterfjord has also been considered, especially the plankton. A survey of the occurrence of the different species in the different months has been prepared. The maximum plankton production (volume per haul) is found in early June. Also a fauna list for the more common species of the benthos and a similar list for the nekton have been compiled.

B. The Østerbø herring.

Topographically the Lusterfjord is wide open towards the Sognefjord and the possibility exists that the Lusterfjord herring also might be found in other places in the Sognefjord area. On the yearly cruises to this area, fishing for this type of herring, has been one of the main items on the programme. So far the trials have not been successful, but on the cruise in the autumn of 1952, some 400 herrings were caught in a "poll", the Østerbøvatn, and on closer examination the herring inhabiting this "poll" seem to constitute a tribe of their own. For this herring the name of "Østerbø Herring" is proposed.

This herring is interesting from various aspects. The Østerbøvatn is quite small, covering only about 2.5 square km. Yet the herring inhabiting it are rather large and of excellent quality. Further, considering the limited space, the lake appears to be densely populated. This may be a temporary phenomenon in view of the rather strange age distribution. Also the local fishermen state the abundance to fluctuate heavily.

The canal connecting the Østerbøvatn with the sea, was dug about the year 1860, and since that time a herring tribe has taken residence in the lake. In all probability it is derived from the winter herring (the southern growth type), which it closely resembles. The differences are so slight that it is hardly justified to class the Østerbø herring as a race of its own. — To sum up: —

- a) The vertebral number in general (57.32 ± 0.10) is higher than for the winter herring, but not much. The vertebral number of the year-classes are partly significantly different from those of the winter herring, partly not.

- b) The mean lengths of year-classes are in some cases smaller than for the winter herring, in other cases larger. The mean length of the Østerbø herring in the autumn of 1952 was 31.58 cm. $\pm$ 0.10 (composed of 5+-year-olds and younger fish).
- c) The mean weight was at the same time 255.6 g. $\pm$ 5.0. The different year-classes show similar relation to the winter herring as stated for the length.
- d) Growth analyses seem to indicate that the Østerbø herring normally grows better than the winter herring. One of the year-classes is "marked".
- e) All these differences, although small, furnish evidence towards establishing the Østerbø herring as a tribe of its own. So also does the fact that the samples show mature fish living in a well defined area on the Norwegian coast when the nearest shoals of the winter herring are located about the Faroes. Moreover, the stages of maturity indicate somewhat later

spawning than for the winter herring. Local fishermen state the spawning to take place in March.

- f) The quality of the Østerbø herring appears to be excellent. The fat content sampled on the 27. October showed 18.8 % against 13.2 % for the winter herring at the same date. Intestinal fat was also more plentiful.
- g) One of the puzzling points about the Østerbø herring is that only young fish (5+ years and younger) was found. The fish matures at the age of 2 to 3 years.

The economical importance of the Østerbø herring is certainly not great. A few local fishermen take occasional catches for home consumption, preferably in summer. On the other hand, from a biological point of view, it is of interest to investigate such local stocks in their niches and surely scores can be found along the extensive Norwegian coast with its numerous fjords.

O. AASEN

B. North Sea and Adjacent Waters.

FISHERIES HYDROGRAPHY

The Scottish Programme of Herring Hydrography, 1952.

During 1951 a series of intensive surveys of the Fraserburgh—Peterhead fishing grounds was carried out from the research vessel "Clupea", and a short report was presented to the Council last year on one aspect of these (CRAIG 1952). The main point made was that herring concentrations tended to be found in areas of higher surface temperature, and this was found to hold roughly until about the beginning of August, when the spawning phase of herring movement was to be expected.

It is scarcely to be expected that herring should correlate perfectly with surface temperature, and in our scientific work we are naturally seeking for fundamental causes which have a rational basis. However, it is obvious that surface temperature is a property easily observed from commercial vessels, and the subject has been followed up to test whether such observations might be helpful in locating concentrations either at the beginning of the season, or after any break in fishing.

In such circumstances there are often occasions when the fleet is spread, and is "feeling" for the most profitable area. A large proportion of the fleet will then be searching with their echo-sounders, and plankton indicator samples may be used to some extent as a guide. The question is whether the odds may be still more reduced by the taking of surface temperature, at least during the greater part of this fishery.

From similar surveys on a slightly extended grid which were conducted by "Clupea" and the Herring Industry Board vessel "Silver Scout" in 1952, combined charts of surface temperature and herring density have been prepared. The surface temperatures are derived by linear interpolation from research ship surveys, while the estimates of herring density have been derived from the weekly distributions of catch and effort for the drift-net fisheries, and from echo-charts obtained during extensive echometer surveys over the area. In those regions where the echometer surveys crossed the grounds fished by the drifter fleets, the correspondence between the plots of herring distribution determined from echometer



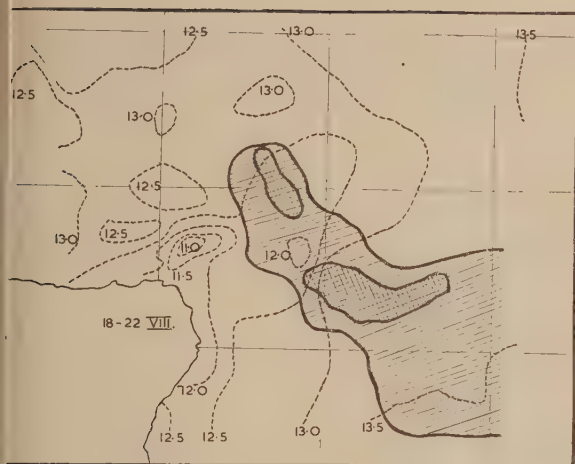


Figure 11 B.

Figure 11 B. Scottish east coast herring fishery 1952. Distribution of herring in relation to surface temperature isotherms.

- a) pecked lines — surface temperature isotherms;
- b) hatched areas — high herring density;
- c) double hatched areas — highest herring density.

tion of the hydrographic situations. The following assessment however may be of interest: —

1. A warm area close to the NE. coast of Scotland appears to result from the confluence of a uniformly warm stream from the Orkney-Shetland Channel with a surface warm stream to the east of Fraserburgh (CRAIG and LOVEGROVE. Paper presented to the North Sea Sub-Committee 1952).

2. It may be that the warm area, which is relatively rich in plankton, appears further west when the heat content of the Orkney-Shetland stream is a large factor in the situation, (as in 1951), and further east when it is less important (as in 1952).

3. In the winter 1951—52, cooling of the North Sea water was about $1\frac{1}{2}^{\circ}$ less than during the winter of 1950—51, and the Orkney-Shetland water dominated the situation less than in that year.

4. It seems a reasonable working hypothesis that the mixed Atlantic and warm coastal inflow through the Orkney-Shetland Channel might be a fundamental factor producing conditions suitable for feeding herring close to the Scottish east coast.

In this connection the series of echo-traces obtained this year from the S.S. "St. Clair", which runs a regular passage from Aberdeen to Lerwick, are interesting. The section of the route which has produced consistently the largest number of echo-traces has been one some ten miles south of Fair Isle, which coincides with the ship's crossing of this warm inflow.

Summary.

Following indications from similar work in 1951, it is shown that during the east Scottish coast herring fishery in 1952 there was from May to July inclusive a rough correlation between herring concentrations and high surface temperature.

R. E. CRAIG
B. B. PARRISH

and the catch statistics was generally high for all surveys, so that the echo-charts have also been interpreted with confidence in those regions covered by the echometer surveys but not fished. Furthermore, the boundaries between areas of high and low herring abundance could be drawn with reasonable precision since both sources of data showed a marked and sudden change in herring abundance between areas giving rise to fairly uniformly high catches and high numbers of "herring" traces and those yielding poor results. The presence of a western and southern herring "front" was particularly marked in May, June, and July.

It will be seen that, in 1952 as in 1951, there is a rough association between higher surface temperature and herring abundance within the area surveyed, except for the inshore area. This latter area became relatively warm during July as would be expected, but there is no evidence of it supporting any large population of adult herring.

The most striking feature, however, is the difference between the May-June distributions of adult herring in the two successive years.

In 1951 the early fishery was concentrated mostly to the north of Fraserburgh and the concentration then moved more eastward, into offshore waters where the temperatures were then rising. In 1952 the fishery began and continued in the eastern area. In both years the fishing was centred in the area of highest surface temperature.

Discussion.

The limitation of detailed observations to two seasons' work prevents any precise evalua-

YOUNG STAGES

Autumn Spawned Herring Larvae in the Northern North Sea.

As a continuation of the programme begun in 1951 Scottish research vessels again carried out a series of cruises to sample the herring larvae spawned in the autumn in the northern North Sea. The area sampled was the same as that reported in Vol. VIII; the cruise periods were 23. August—8. September, 11.—18. October, 8.—26. November and 1.—22. December. Additional sampling in the Moray Firth and off the Aberdeenshire coast was carried out in August and early September. As in the previous year several of the surveys were restricted by unfavourable weather conditions.

The results of the 1952 work as regards spawning period and spawning centres gave clear confirmations of the conclusions reached as a result of the previous year's work in the area. Newly hatched larvae were again absent until the third week of August and occurred thereafter until the beginning of October. The spawning centres coincided closely with those of the previous year, viz:— a coastal belt within the forty-fathom contour between Kinnaird Head and Girdleness; and over Turbot Bank. The Orkney grounds were not sampled during the spawning period, so there is no confirmation of Pappa Bank as a spawning centre. Spawning also occurred in the Moray Firth over West Bank and Bosies Bank but on a much smaller scale than in the other localities mentioned.

The coefficient of growth deduced from the 1952 data is an increase of 0.0038 per day in the logarithm of the length. This is slightly lower than the 1951 figure but the difference is probably not significant and the two figures are sufficiently close to strengthen the previous conclusion that the growth of autumn spawned larvae is markedly slower than that of those spawned in spring.

Larval drift showed similar characteristics to that of 1951. The predominant direction of movement was southerly — those sampled in September to the east of Orkney drifting along the outer edge of the Moray Firth to reach the vicinity of the Buchan Deep by December, whilst those spawned on Turbot Bank and off the Aberdeenshire coast spread southwards and had reached the region of the Farne Deep by December. There was as in the previous

year no indication of a major loss of larvae from the area due to easterly transport.

There was a marked difference between 1951 and 1952 in the abundance of herring larvae. On the southern grounds — i.e., those off the Aberdeenshire coast — small larvae in 1952 were about six times more abundant during the spawning period than in 1951. Sampling of the grounds around Orkney was not sufficiently comparable between the two years to allow of a comparison for that region, but from the abundance of later larvae sampled drifting across the outer Moray Firth the reverse seems to be the case and spawning may have been more intense in that region in 1951 than in 1952. The data are not completely suitable for mortality estimates but for both years the estimates were similar at about 3 % per day.

ALAN SAVILLE

0- and I-group. Scotland 1951-1952.

Sampling of the 0- and I-group herring in east Scottish coastal waters was continued in 1951—52. In addition to the samples taken during research vessel trawling surveys and from commercial drift- and ring-net fisheries as in previous years, samples were also obtained by exploding small charges of gelignite among shoals located by echo-sounder in shallow water.

Landings of "halfin" herring (I-group) from the upper reaches of the Moray Firth in the winter of 1951—52 reached the record total of 19066 crans with an average catch per landing of 24 crans. This fishery, which is carried on with small-mesh drift-nets, usually commences in October and ends either in December or March. The shoals left the grounds in December 1951 but re-appeared at the end of January 1952 and nearly three-quarters of the total catch were landed between then and the end of March.

The particulars of the samples examined in 1952 are given in Table 6. These data show that the "halfin" stock in the Moray Firth was composed of fish hatched in the period autumn 1949 — spring 1950. This brood also made up the stock of "halfin" herring in the Firth of Forth where there was a fairly successful ring-net fishery on a mixed stock of "half-lins", 0-group herring and sprats.

The same brood later figured prominently as 2-ringers in the summer drift-net fishery off

Table 6. Length and Mean Vert. S. of 0- and I-Group Herrings caught in the Inshore Waters of the Scottish East Coast.

(Numbers in brackets).

Locality	Month, Year	Range, cm.	Mean Length, cm.	Mean Vert. S.
0-Group, i.e., Autumn 1951 Brood				
Inverness Firth	Sep. 1952 ¹⁾	8—10	8.64 (454)	56.41 (90)
	— ¹⁾	9—12	10.54 (91)	56.36 (90)
0-Group, i.e., Autumn 1950 and Spring 1951 Broods				
Firth of Forth	Mar. 1952 ²⁾	8—15	11.00 (205)	56.47 (203)
	Apr. —	9—17	11.38 (594)	56.50 (178)
St. Andrews Bay	Oct. 1951	7—10	7.85 (636)	56.47 (98)
Aberdeen Bay	Nov. —	9—14	10.19 (31)	56.73 (30)
	Dec. —	9—14	10.81 (793)	56.43 (101)
	Feb. 1952	8—14	10.81 (227)	56.50 (103)
	—	12—17	14.10 (164)	56.60 (70)
Inverness Firth	Mar. — ¹⁾	10—16	11.49 (352)	56.47 (162)
Dornoch Firth	Jan. —	11—17	13.24 (847)	56.49 (92)
	May —	10—16	12.18 (60)	56.59 (58)
I-Group, i.e., Autumn 1949 and Spring 1950 Broods				
Firth of Forth	Feb. 1952 ²⁾	20—24	22.86 (195)	56.70 (195)
	Mar. — ²⁾	18—25	21.73 (245)	56.56 (245)
	Apr. —	18—24	19.89 (27)	56.63 (24)
Inverness Firth	Oct. 1951 ³⁾	18—24	20.70 (251)	56.59 (251)
	Nov. — ³⁾	18—24	22.01 (246)	56.67 (246)

¹⁾ Explosives Samples. ³⁾ Drift-net Samples.²⁾ Ring-net Samples. All others caught by trawl.

the Scottish north-east coast where again the vertebral counts were indicative of a mixture of spring and autumn progeny (see p. 183).

The spring brood of 1951 made a much smaller contribution to the 0-group catches in 1951—52 than the spring brood of 1950 made to the 0-group catches in 1950—51 (Ann. Biol., Vol. VIII, pp. 141—2) and most of the 0-group herring sampled between October 1951 and May 1952 belonged to the 1950 autumn brood.

The catch per hour of 0-group herring by F.R.V. "Kathleen" was less than during the previous winter.

Period	Hrs. fishing	Total Catch	Catch pr. Hr.
Novr. 1951-Mar. 1952	29½	1,130 herring	38.3

G. McPHERSON

Young Herring from the Bløden Ground Area.

As in 1951 a Danish trawl fishery for young herring for processing in the meal factories in Esbjerg took place in the "Bløden" ground area in 1952. Like the preceding year the fishery was carried out in two seasons: a spring fishery starting in January and closing in April and an autumn fishery from July to October.

The spring fishery yielded about 7 mill. kg. and the autumn fishery ca. 25 mill. kg. The total yield in 1952 (ca. 32 mill. kg. including small amounts of whiting) was, thus, about

Table 7. Herring Samples from the Bløden Ground Area 1952.

Percentage, length and meristic characters of the year-classes 1950 and 1949.

	Year-class 1950						Year-class 1949					
	Spring 1952				Autumn 1952		Spring 1952				Autumn 1952	
Date of sample	27.-1.	21.-2.	15.-3.	1.-4.	30.-7.	8.-8.	27.-1.	21.-2.	15.-3.	1.-4.	30.-7.	8.-8.
No. of spec. . .	0	34	70	39	198	176	177	131	124	133	7	17
% of sample. .	0	20.2	34.3	21.0	96.6	91.2	92.2	78.0	60.8	71.5	3.4	8.8
Length-distrib. in cm. (%)												
13.....	9	—	15	—	—	—	—	—	—	—	—	—
14.....	21	4	18	—	—	—	—	2	—	—	—	—
15.....	18	6	21	—	—	—	—	—	—	—	—	—
16.....	6	24	28	—	6	1	—	5	1	1	—	—
17.....	38	41	13	—	56	22	2	18	5	3	—	—
18.....	3	23	—	—	29	38	39	20	43	20	9	—
19.....	6	1	5	—	10	23	35	36	25	29	26	—
20.....	—	—	—	—	4	11	13	29	6	26	35	13
21.....	—	—	—	—	—	3	7	11	2	15	15	30
22.....	—	—	—	—	—	1	3	2	1	4	9	57
23.....	—	—	—	—	—	—	1	—	—	1	1	—
24.....	—	—	—	—	—	—	—	—	—	1	—	24
Aver. length. .	16.3	17.3	15.8	—	18.0	18.9	19.5	19.8	18.6	19.9	20.3	21.9
V. S.	56.77	56.69	56.70	—	56.55	56.63	56.49	56.53	56.51	56.68	56.61	—
K ₂	14.32	14.75	14.40	—	14.93	14.81	14.95	15.06	15.06	14.97	14.96	—
Total V. S. . .					56.59							56.58
— K ₂					14.84							15.02

the same as in 1951. 4 samples from the spring and 3 from the autumn have been analysed and the percentage, length distribution and meristic characters of the two dominant year-classes, 1949 and 1950, are given in Table 7. Besides these two year-classes the samples contained a few percentages of older herring mainly of the 1948 year-class.

As in 1951 (cf. Ann. Biol. Vol. VIII, p. 141) most of the catch in the spring consisted of herring with their second winter-ring at the edge of the scale (the 1949 year-class) while in the autumn the following year-class (1950) was dominant. Thus, the spring fishery of 1952 was based mainly on the same year-class (1949) as the autumn fishery of 1951. In the sample from October a few percentages of the 1949 year-class and most of the few older herring were in maturity stage III-IV. Except for these, all the herring examined were immature.

The average length of the herring of the 1950 year-class was 16—17 cm. in the spring samples increasing to 18—19.5 cm. in the autumn samples. The averages observed in spring may be somewhat higher than the true average in the stock due to selection caused by the fishing method. The average length of the 1949 year-class was 18.6 to 20.3 cm. in spring and 22 to 23 cm. in the autumn. The samples thus indicate a rapid growth of the herring in the period April to July and a slow growth during the rest of the year.

That the food consumption of these herring is small in the period from August to April appears clearly from the analyses of their fat content carried out by the Technological Laboratory, Ministry of Fisheries. According to these analyses the fat content of herring of about 20 cm. length decreased in spring from about 13 % in late January to about 3 % in the beginning of April; during the summer it increased to ca. 20 % and fell again during the autumn to ca. 15 % in October.

The meristic characters of the herring (average for all samples V.S. 56.6 and K_2 14.9) agree with those of autumn spawners from the western North Sea.

Investigations on the hydrography and the distribution of plankton on the "Bløden" ground and surrounding areas were carried out by the "Dana" in April—May and late August and some samples were collected by "Jens Væver" in September and October. The

autumn concentration of herring in the "Bløden" ground area may have some connexion with the presence in summer and autumn of a bottom layer of cold water in this area (cf. North Sea report, Hydrography, p. 104).

E. BERTELSEN and K. POPP MADSEN

COMMERCIAL FISH

Scottish Fisheries.

East coast and Shetland.

The commercial fisheries for herring in the North Sea in 1952 followed the same general pattern as in previous years. In April, a small fleet of English drifters commenced working in the north-eastern region of the North Sea, in the vicinity of Viking and Coral Banks. This fishery continued until mid-June. The drift-net fisheries conducted from Lerwick in the Shetlands and Fraserburgh and Peterhead on the Scottish east coast commenced in early May and continued until the first week in September, when the fleets were diverted to other areas. These fisheries, and particularly that operating from Fraserburgh and Peterhead, were much more productive than in recent years. A relatively high yield was maintained from the beginning of the season up to the middle of August when the catches fell off markedly.

From July until November a small fleet of Swedish and Scottish trawlers landed herring at Aberdeen from the region of the Fladen Ground and the "Gut".

The crude statistics of these fisheries are given in Table 8 together with those for 1950 and 1951, and monthly charts of the distribution of effort and average catch per 10 mile square for the major drift-net fisheries are presented in Charts 1—10. As in 1951 the effort statistics refer to the number of hauls made in each square in each month, and the catch figures are the average catches per haul per square, calculated on the basis of 100 nets per haul.

The most striking difference between the east coast fisheries in 1952 and 1951, revealed by the monthly catch charts, was the establishment of a successful fishery in May 1952 on grounds between 40 and 60 miles from the landing ports, whereas in 1951 the May fishery was more widespread on the nearer grounds. In 1952 a productive fishery was maintained on the offshore grounds throughout May, June

Number of Arrivals.



Charts 1—5.

Catch.



May

June

July

August

September

Charts 6—10.

Table 8. East Coast and Shetland Herring Landings.

	Drift-net								
	Landings (crans)			Arrivals (hauls)			Average catch ¹⁾ per arrival (crans)		
	1950	1951	1952	1950	1951	1952	1950	1951	1952
Fraserburgh.....	70,478	95,073	188,207	4913	7907	8468	14.3	12.0	22.2
Peterhead.....	27,922	42,581	106,405	2164	3081	4072	12.9	13.8	26.1
Lerwick.....	53,110	31,463	49,180	3361	1916	2415	15.8	16.4	20.4

	Landings (crans)			Herring trawl			Landings per 100 hrs. (crans)		
				Hrs. fishing					
Fladen.....	10,375	16,425	18,983	6123	7111	9773	169.4	231.0	194.2
Gut.....	—	—	5,043	—	—	1363	—	—	370.0

¹⁾ These figures not adjusted to basis of 100 nets per haul.

and July, and not until late August did the effort become centered within the 40 mile radius.

Length, Age and Racial Composition of Samples.

Coral Bank.

A single sample of herring was taken from the landings of drifters working on the Coral Bank in April 1952. The length, age, maturity and Vert. S. data, obtained from this sample are contained in Table 9 A-D.

These results and reports from fishermen working in this area show that the stock present on the grounds at this time was composed mainly of spawning herring between 3—5 years of age. This is in marked contrast to the results obtained from the same area in 1950

and 1951 when older autumn spawners predominated. It is interesting to record that 4 herring tagged on the Coral Bank in April, were recaptured subsequently in the Skagerak, but no recaptures of fish liberated in this area were made in the north-western North Sea fisheries.

North-east coast and Shetland.

The length and age compositions of the herring sampled at Fraserburgh, Peterhead and Lerwick in each of the months May—August 1952, are presented in Figure 12, and the maturity and Vert. S. data are given in Table 10 A and B.

The most striking feature of the stock, revealed by these samples, was the appearance of an abundant two-year-old year-class

Table 9. Length, Age, and Racial Composition of Coral Bank Sample.

A. Length Composition.										Mean Length	No. of Fish
Length (cm.).....	25	26	27	28	29	30	31	32	33		
No. per mille.....	8.0	115.5	422.3	259.0	107.6	47.8	15.9	19.9	4.0	27.7	250

B. Age Composition.											
No. of Winter rings	3	4	5	6	7	8	9	10	11		
Year of hatching ¹⁾	1948—49	1947—48	1946—47	1945—46	1944—45	1943—44	1942—43	1941—42	1940—41		
%.....	26.7	44.5	19.5	4.1	0.88	0.8	0.8	2.0	0.8		

C. Maturities (all Age-Groups).											No. of Fish
Stage	I	II	III	IV	V	VI	VII				
%.....	0.8	1.2	—	—	—	82.1	15.9				250

D. Vert. S. (all Age-Groups).											
No. of Vertebrae.....	55	56	57	58	59	Mean	Total				
No. of Fish.....	1	43	167	37	—	56.97	248				

¹⁾ Year of hatching includes the period from the summer spawning season in one year to the spring spawning season in the next year, e.g., fish with 3 winter-rings were hatched in period summer 1948/spring 1949.

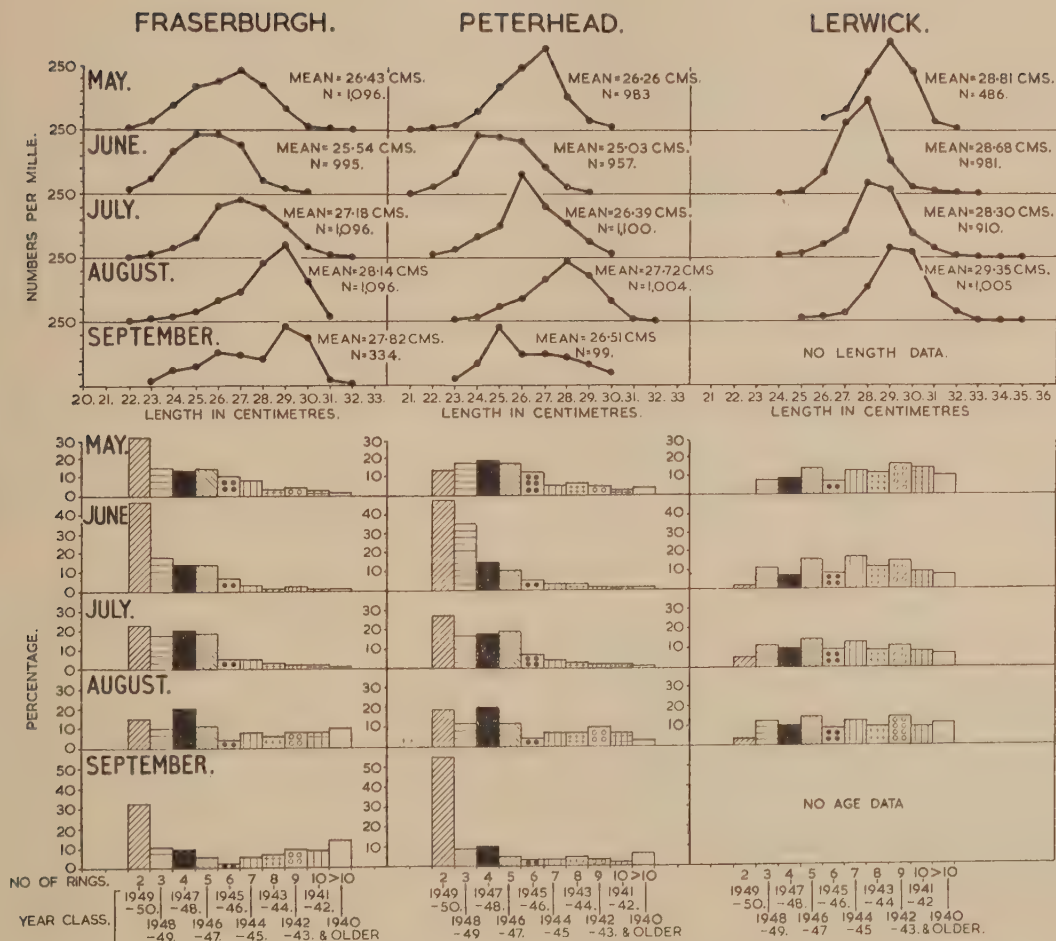


Figure 12. Length and age composition of north-east coast and Shetland drift-net herring samples. May-September 1952. (Length frequencies unsmoothed).

(hatched autumn 1949—spring 1950) on the east coast grounds in 1952. This brood was particularly prominent in June when it constituted almost 50 % of the herring sampled at Fraserburgh and Peterhead.

The mean vertebral counts of the fish of this year-class in the Fraserburgh samples in the different months were as follows:—

May	=	56.70	(314)
June	=	56.62	(445)
July	=	56.55	(267)
August	=	56.51	(158)
September	=	56.52	(69)

The May and June figures indicate that this

year-class was composed of a mixture of spring- and autumn-spawned fish. This was confirmed from otolith analysis, which gave the proportions of winter- and spring-spawned and summer- and autumn-spawned herring during these months as about 40 % and 60 % respectively. In July, August, and September less of the winter- and spring-spawned members of this year-class were encountered, and it was composed mainly of autumn-spawned herring in maturity stages III—V.

The remainder of the stock on these grounds was composed mainly of maturing autumn-spawning herring, between 3—11 years of age.

Table 10. Maturity and Racial Characters. East Coast and Shetland.

Maturity Stage	A. Percentage Maturity (all Age-Groups)													
	Fraserburgh					Peterhead					Lerwick			
	M.	J.	Jy.	Aug.	S.	M.	J.	Jy.	Aug.	S.	M.	J.	Jy.	Aug.
I.....	29.3	27.0	7.8	1.0	—	17.6	28.0	10.6	1.2	—	1.9	7.8	7.4	9.4
II.....	24.9	50.6	30.9	2.5	—	39.4	54.5	34.5	2.5	—	47.8	56.1	32.8	18.5
III.....	0.8	2.6	23.3	10.9	3.6	0.3	2.9	22.0	9.2	14.1	1.9	18.8	32.0	17.3
IV.....	0.1	0.8	16.7	26.4	4.2	—	0.1	18.1	38.7	21.2	1.0	3.0	13.4	23.9
V.....	—	—	15.6	21.1	3.6	—	0.1	11.9	16.3	8.1	—	—	5.2	8.7
VI.....	—	—	2.5	18.1	67.9	0.1	—	0.8	13.2	10.1	0.2	—	0.3	1.3
VII.....	45.0	19.0	3.2	20.2	20.7	42.6	11.9	2.1	19.0	46.5	47.2	14.2	9.0	20.9
No. of Fish.....	1061	994	1144	1096	333	983	956	1099	1004	99	485	979	910	1003
No. of Vertebrae	B. Vert. S. (Actual Numbers - all Age-Groups).													
54.....	—	2	1	1	—	—	1	1	—	—	—	—	1	—
55.....	32	38	34	61	17	14	27	21	42	5	30	19	26	16
56.....	420	416	479	505	153	207	266	351	369	44	204	258	375	200
57.....	546	460	518	445	127	241	312	373	309	40	207	301	417	235
58.....	76	64	82	57	12	22	46	45	29	3	33	39	74	51
59.....	3	—	4	2	—	—	1	3	2	—	—	2	1	3
Mean.....	56.63	56.56	56.59	56.47	56.43	56.56	56.58	56.57	56.44	56.45	56.51	56.59	56.60	56.65
No. of Fish.....	1007	980	1118	1071	308	484	653	794	751	92	474	619	894	505

M. = May, J. = June, Jy. = July, Aug. = August, S = September.

The two-year-old year-class failed to appear in such large numbers in the Shetland area, where a stock consisting mainly of maturing autumn spawners were present on the grounds during the season. However small numbers of large spring spawners (four and five winter-rings), with distinctive otoliths and scales showing "Norwegian" characters, were present in these samples. It is interesting to record also that three herring tagged off the Norwegian coast, were recaptured on the Shetland grounds during the 1952 fishery.

Fladen.

The length and age compositions of herring sampled during the Fladen trawl fishery from Aberdeen in the period August—October are presented in Figure 13, and the maturity and Vert. S. data are given in Tables 11 A and B.

These data indicate that the Fladen stock in August was composed mainly of maturing late autumn-spawning herring, except for those

with two winter-rings, which as in the drift-net grounds, were a mixture of spring- and autumn-spawned herring. In September older spent herring probably derived from the east-coast spawning grounds invaded the area and these constituted a relatively large proportion of the stock in the latest sampling period.

In September 1952, a single sample of herring was obtained from a herring trawler catch taken in the "Gut" (statistical square F 12), the deep-water channel to the south of the Fladen Ground. The length, age, maturity and vertebral count data are given in Table 12 A—D.

This sample is interesting in that it contained two groups of herring, spent summer spawners and late autumn and winter spawners in maturity stages III—VI. The spent and maturing fish were distributed amongst all age-groups. As in the summer drift-net fishery further to the north, the two-ringers were

Table 11. Maturity and Racial Characters.

A. Percentage Maturity (all Age-Groups).								B. Vert. S. (Actual Number — all Age-Groups).							
Sampling period	Maturity Stage							No. of Vertebrae							
	I	II	III	IV	V	VI	VII	No.	54	55	56	57	58	59	Mean
7.—8. August. . .	8.3	20.7	19.4	27.2	24.4	—	—	180	—	2	92	77	6	—	56.49
14. August.	24.9	13.1	14.9	27.1	20.1	—	—	229	1	9	73	101	16	—	56.61
4.—10. Sept.	2.5	1.5	13.8	20.7	32.5	2.0	27.6	203	—	10	94	87	7	—	56.46
26. Sept.—17. Oct.	10.3	9.0	4.7	2.6	1.1	—	72.4	468	—	26	220	185	20	1	56.45

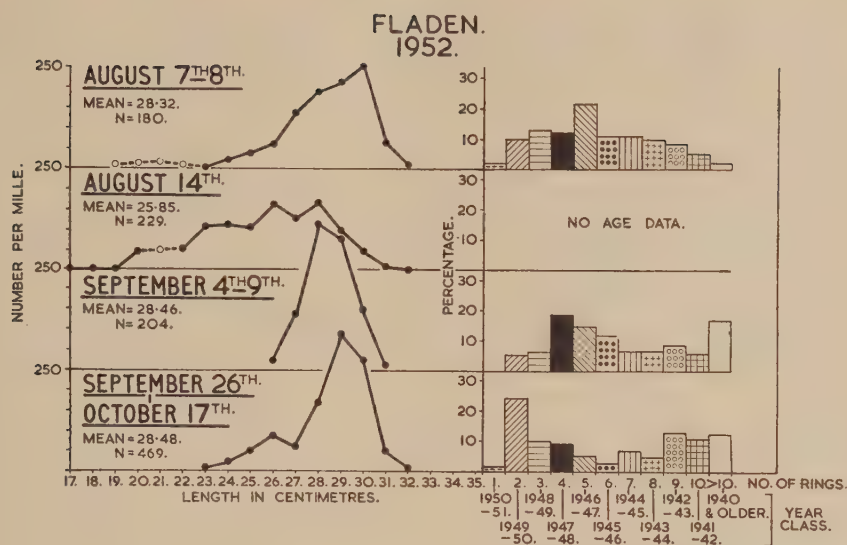


Figure 13. Length and age compositions of Fladen herring trawl samples.
August—October 1952. (Length frequencies unsmoothed).

composed of fish of mixed autumn and spring origin.

Firth of Forth.

Samples were taken from the "haflin" fishery in the upper reaches of the Firth of Forth in the period January to March 1952. These herring were mostly one- and two-year-old fish of autumn- and spring-spawning origin. There was again no evidence of a return to the

outer Firth of substantial quantities of adult spring spawning herring.

West coast.

1. Minch.

The fisheries in the Minch followed the same general pattern in 1952 as in the previous year. The winter fishery (January—March) in the north Minch produced disappointing results, but this was followed in this area by a success-

Table 12. Length, Age and Racial Composition of "Gut" Sample.

A. Length Composition										
Length (cm.)	23	24	25	26	27	28	29	30	Mean Length	No.
No. per mille	28.0	44.0	60.0	92.0	212.0	248.0	272.0	44.0	27.5	250
B. Age Composition										
No. of winter-rings	2	3	4	5	6	7	8	9	10	10
Year of hatching ¹⁾	1949—50	1948—49	1947—48	1946—47	1945—46	1944—45	1943—44	1942—43	1941—42	1940 and older
%.....	15.4	7.7	12.2	17.0	17.5	3.3	5.7	7.3	6.1	7.8
¹⁾ See note at foot of Table 9 B.										
C. Maturities (all Age-Groups)										
Stage.....		I	II	III	IV	V	VI	VII	No. of Fish	
%.....		3.2	3.6	11.7	30.6	11.5	2.8	36.6	250	
D. Vert. S. (all Age-Groups)										
No. of Vertebrae.....		55	56	57	58	59	Mean	Total		
No. of Fish.....		7	113	118	9	1	56.53	248		

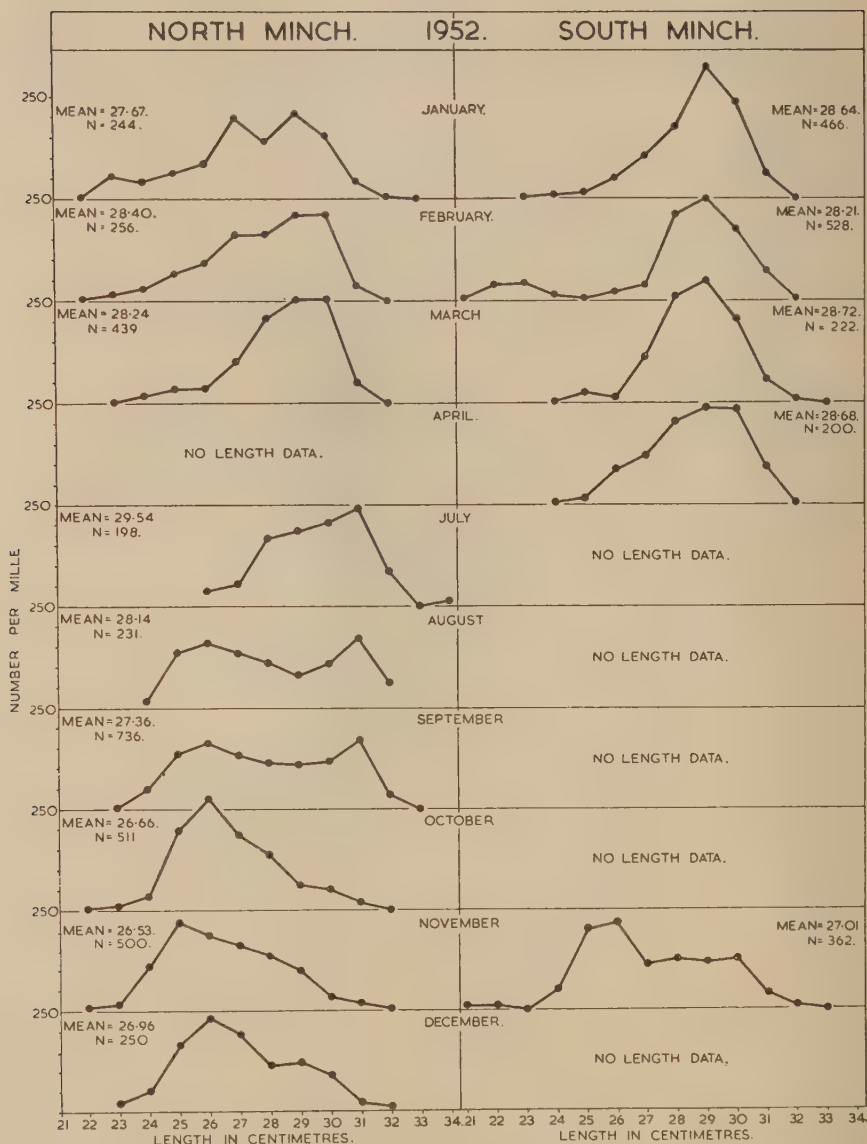


Figure 14 A. Length composition of west coast herring samples. (Frequencies unsmoothed).

ful summer and autumn fishery (June—September). The south Minch fishery throughout the year was rather less productive than in 1951.

Table 13 gives the crude statistics for the drift-net and ring-net fisheries of the north and south Minch in 1952, together with those for the two preceding years for comparison.

The total yield and catch per unit of effort in the north Minch drift-net fishery were higher in 1952 than in the two previous years, but were lower in the ring-net fishery, while the south Minch landings were similar to 1951 by drift-net but rather lower by ring-net.

Sampling of the Minch stocks was continued in 1952 on an intensified scale, especially on

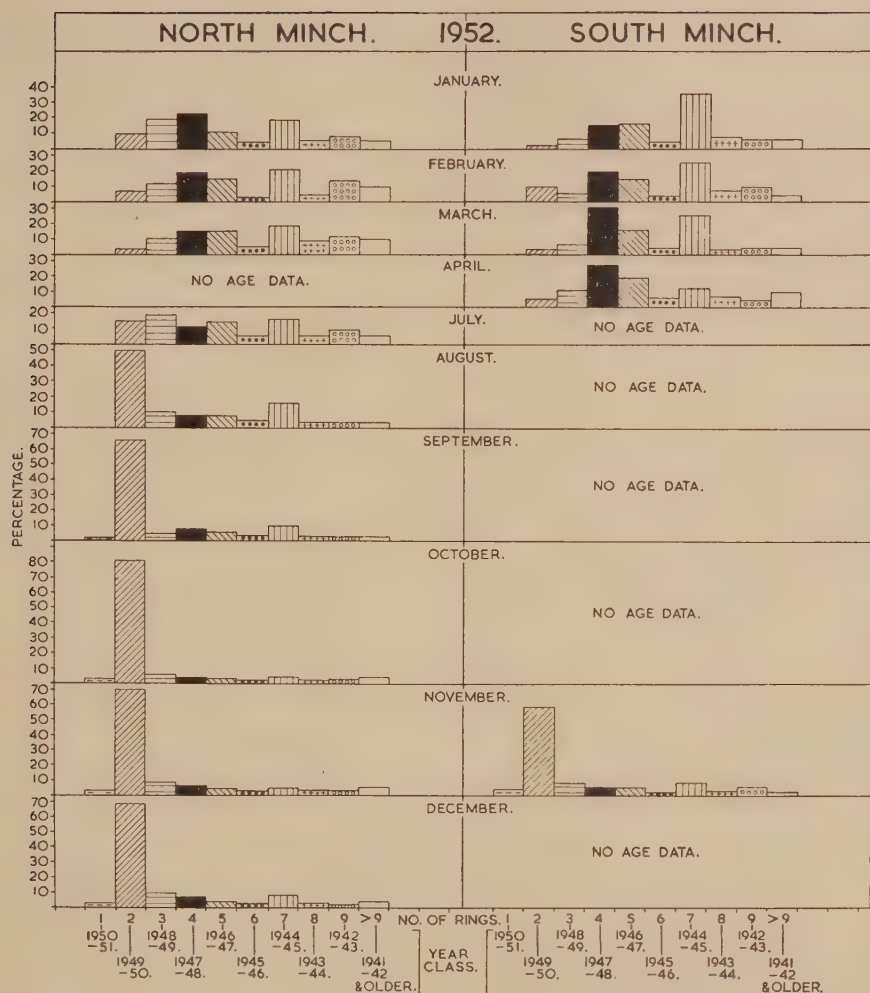


Figure 14 B. Age composition of west coast herring samples, January–December 1952.

Table 13. West Coast Herring Landings.

	Drift-Net					
	North Minch				South Minch	
	Landings (crans)	No. of Arrivals	Landings per Arrival (crans)	Landings (crans)	No. of Arrivals	Landings per Arrival (crans)
1950.....	106,221	9,274	11.5	8,733	188	46.5
1951.....	101,771	7,200	14.1	23,053	773	29.8
1952.....	149,456	8,526	17.5	23,255	796	29.2

Ring-Net						
	Landings (crans)	No. of Arrivals	Landings per Arrival (crans)	Landings (crans)	No. of Arrivals	Landings per Arrival (crans)
1950.....	35,605	1,006	35.3	52,234	1,773	29.4
1951.....	28,077	953	29.5	48,818	1,982	24.6
1952.....	20,195	904	22.4	32,717	1,159	28.1

the northern stock. The length and age compositions of the samples are given in Figures 14 A and B and the maturities and mean Vert.

S. for different maturity stages are presented in Table 14 A and B. It is important to note that, while the north Minch data are from

Table 14. Maturity and Vert. S. Composition of North and South Minch Samples.

Maturity Stage	A. Percentage Maturity (all Age-Groups).										South Minch				
	North Minch														
	Jn.	F.	M.	Jy.	Au.	S.	O.	N.	D.		Jn.	F.	M.	A.	N.
I.....	16.4	15.6	5.5	19.2	21.7	17.0	11.3	9.8	16.8		4.3	11.5	3.6	5.0	10.2
II.....	12.3	16.4	8.9	32.3	27.3	11.2	19.0	7.6	7.2		22.9	13.4	14.9	9.5	14.3
III.....	2.5	2.4	0.7	13.6	20.7	24.5	9.2	14.0	16.8		1.7	0.2	0.4	0.5	8.3
IV.....	4.5	2.7	2.7	17.7	16.8	10.7	1.4	4.0	4.4		2.2	0.3	—	—	2.5
V.....	4.5	5.5	2.3	11.6	8.7	2.0	0.6	0.6	0.8		2.2	6.6	—	—	0.3
VI.....	—	—	0.2	—	—	0.4	—	—	—		—	0.2	—	—	—
VII.....	59.8	57.4	79.7	5.6	4.8	34.2	58.5	64.0	54.0		66.7	67.8	81.1	85.0	64.4
No.....	244	256	439	198	231	736	511	500	250		466	528	222	200	362

B. Mean Vert. S. for each Maturity Stage.

(Nos. in brackets are No. of fish).

Maturity Stage	North Minch										South Minch				
	Jn.	F.	M.	Jy.	Au.	S.	O.	N.	D.		Jn.	F.	M.	A.	N.
I.....	56.75 (40)	56.42 (38)	56.55 (22)	57.00 (36)	56.80 (49)	56.78 (125)	56.84 (58)	56.63 (48)	56.55 (42)		56.67 (20)	56.63 (57)	56.75 (8)	57.10 (10)	56.73 (34)
II.....	56.53 (30)	56.60 (40)	56.56 (39)	56.89 (64)	57.00 (62)	56.70 (82)	56.75 (96)	56.86 (38)	56.71 (17)		56.50 (107)	56.42 (71)	56.73 (33)	56.44 (18)	56.67 (54)
III.....	57.00 (7)	57.00 (6)	56.33 (3)	56.23 (26)	56.71 (48)	56.74 (174)	56.83 (47)	56.86 (70)	56.93 (42)		57.25 (8)	57.00 (1)	—	57.00 (1)	56.93 (29)
IV.....	57.00 (11)	56.86 (7)	56.75 (12)	56.60 (35)	56.54 (39)	56.71 (65)	57.29 (7)	56.88 (17)	57.00 (11)		57.00 (10)	57.00 (2)	57.00 (1)	—	56.67 (9)
V.....	56.91 (11)	56.85 (13)	57.20 (10)	56.57 (21)	56.45 (20)	56.71 (10)	57.00 (3)	58.00 (3)	56.50 (2)		56.80 (10)	56.85 (33)	—	—	57.00 (1)
VI.....	—	—	57.00 (1)	—	—	56.67 (3)	—	—	—		—	57.00 (1)	—	—	—
VII.....	56.40 (146)	56.48 (142)	56.47 (342)	56.73 (11)	57.00 (7)	56.56 (252)	56.56 (288)	56.54 (318)	56.59 (133)		56.48 (309)	56.42 (351)	56.55 (178)	56.45 (170)	56.56 (223)
Overall Mean....	56.54	56.53	56.51	56.73	56.77	56.68	56.67	56.64	56.56		56.53	56.47	56.59	56.49	56.63

Jn. = January, F. = February, M. = March, A. = April, Jy. = July, Au. = August, S. = September, O. = October, N. = November, D. = December.

samples taken from drift-net catches, the south Minch ones are from ring-net catches, except the March sample which was also from a drift-net catch.

The maturity and Vert. S. data from both areas indicate that the stocks fished throughout the year contained a high proportion of autumn spawning herring. These were present in the spring and autumn fisheries as recovering spents and spents respectively. The age data show that the two-year-old brood became prominent in the stock during the summer months, and from July to the end of the year it predominated in the catches from the north Minch. Vertebral counts and otolith types indicate that this brood, as in the east coast area, was composed of a mixture of spring- and autumn-spawned herring.

2. Clyde.

Sampling of the Clyde herring stock was carried out at intervals during the year.

Samples were obtained from the upper reaches of the Firth during the summer, and in the outer reaches during the winter. These data showed that, in keeping with earlier results, the upper Firth fishery was centred on adolescent herring between 2 and 5 years of age, mainly of spring-spawning origin, whilst the outer Firth stock was of young native spawners with a small admixture of older spawners from other sources. The yields from the fisheries in both areas were poor, and no evidence was obtained of any substantial increase in the stock of adolescent herring in the Firth.

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I. G. BAXTER J. D. BUCHAN

Tagging Experiments.**A. Scottish work.**

Extensive tagging experiments were continued in the Scottish fisheries in 1952. A total of 18,311 herring were tagged during the year, the centres of tagging being the drift-net fishing

Tagging Experiments, 1952.

Area	NE. coast grounds, 24. April to 21. August				Shetland grounds, 29. May to 2. August			
	"Lea" tag 794; "Scottish" tag 8326.				"Lea" tag, 518; "Scottish" tag, 2461.			
	Recaptures Number		Days free		Recaptures Number		Days free	
	"Lea"	"Scottish"	"Lea"	"Scottish"	"Lea"	"Scottish"	"Lea"	"Scottish"
On Shetland grounds...	—	—	—	—	—	2	—	3-12
On NE. coast grounds...	2	2	0-43	0-118	1	—	63	—
Fladen.....	18	96	11-89	1-109	8	33	5-102	28-149
Gut..... off NE.	—	9	—	7-103	—	1	—	84
England ..	2	2	52-69	36-113	—	—	—	—
NW. Dogger.	1	13	92	26-161	1	—	96	—
East Anglian grounds...	1	2	130	123-135	—	—	—	—
Skagerak....	—	1	—	206	1	—	218	—
unknown....	6	20	up to 97	up to 90	—	5	—	—
Total (all areas)	30	145			11	41		
Percentage...	3.8	1.7			2.1	1.6		

Minch Taggings, 1952.

North Minch Taggings			Recaptures		
Date	Tag	No.	Area	No.	Days free
²⁰ / ₂ — ⁸ / ₃	Lea	200	N. Minch	2	1—44
	Scottish	889	»	3	4—27
³⁰ / ₇ — ¹⁶ / ₈	Lea	300	»	1	1
	Scottish	1996	{ S. Minch	7	22—195
				4	115—157
Total: Lea,			3	Scottish, 14	
Percentage: »			0.6	»	0.5
South Minch Taggings			Recaptures		
Date	Tag	No.	Area	No.	Days free
²⁵ / ₆ — ⁴ / ₇	Lea	125	Unknown	1	?
	Scottish	354	{ Stanton Bk.	1	47
			{ Unknown	1	?
¹¹ / ₁₁	Scottish	150	S. Minch	1	
Total: Lea,			1	Scottish, 3	
Percentage: »			0.8	»	0.6

(NB: Stanton Bank = SW. of Barra Hd., Hebrides)

grounds off the Scottish north-east coast and the Shetlands in the period April—August, the Firth of Forth in January and March, the "Coral" Bank in April, and the Minch herring grounds between February and November.

As in 1951, the tagging was carried out almost entirely from commercial fishing vessels and the one man "toggle" attachment was used in all experiments. Two types of tag were

employed with this attachment, the "Lea" hydrostatic (1,933) and the "Scottish" hydrostatic (16,318).

A series of different colours of the Scottish tag were employed during the course of these experiments so as to gauge the most suitable colour for large-scale liberations, and in April, tagging experiments were conducted off the Swedish coast to test the relative merits of the Scottish and Swedish tagging techniques. Interim results of these experiments were reported to the Council in October 1952, and full details will be published at a later date.

Firth of Forth.

529 "haflin" (I-group) herring from ring-net catches, were tagged in the upper reaches of the Firth in January and March 1952. The purpose of this experiment was to gauge the direction of movement of herring outwards from the estuary in their third summer. 18 recoveries were reported in 1952, but all came from the neighbourhood of the tagging area during the fishery there.

Coral Bank.

Of the 1,308 herring tagged from commercial drifters on the Coral Bank in April, 6 recaptures have been reported to date. One herring was recaptured in the Nisum Broad, Denmark, in May, and four on or near the Helsebank in the Skagerak in the period 27. June and 8. July. The sixth recovery came from the southern end of the "Gut" in August.

Scottish NE. coast and Shetland.

As in 1951, the greatest tagging effort was centred on the drift-net grounds off the Scottish NE. coast and at Shetland. A summary of the liberations and recaptures is given above.

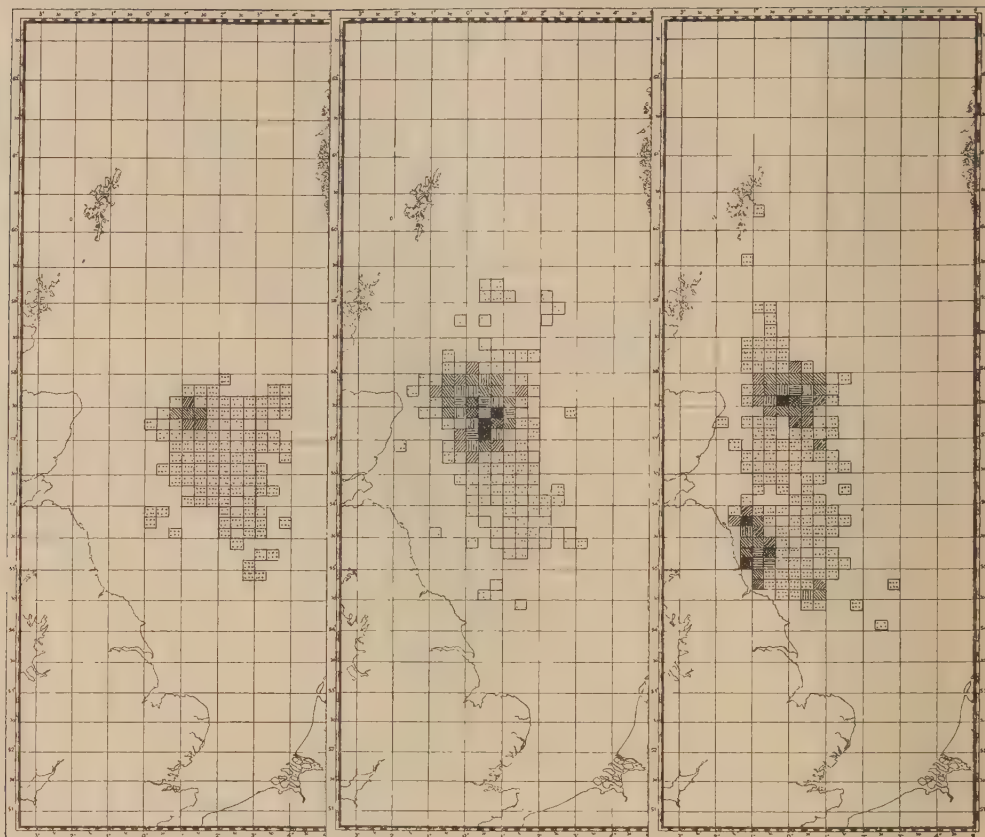
The movements revealed by these results are in general agreement with those recorded in the previous year. (Ann. Biol. Vol. VIII, 1951). It is of interest, however, that in 1951 almost all of the herring recaptured on the southern North Sea grounds and in the Skagerak were liberated in May, whereas in 1952, the recaptures in these areas were from liberations in May (9), June (12) and July (2).

Minch.

Tagging on the Minch grounds was carried out on four occasions during the year. The results of these experiments are given above.

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I. G. BAXTER

Number of Shots.



Charts 1—3.

May

June

July

B. English work.

Herring tagging was carried out again during 1952. Work was centred in three main areas. 1,349 fish were tagged in the Whitby fishery during August and September. In October and November 1,310 fish were tagged in the Smith's Knoll area. In January, February and December, despite unfavourable weather conditions, 293 fish were tagged off Cape Gris Nez. In all, 15 fish have been returned so far. While most of these returns have been within a few days of liberation, one fish was recaptured seven months after being tagged.

As a result of experimental work carried out in 1952, two types of tag will be used in 1953. These will be: (1) Lea Hydrostatic, fitted by a wire bridle, and (2) Hodgson Plastic tag, which is attached to the fish by a wire and nylon toggle.

G. C. BOLSTER

The Dutch Herring Fisheries in 1952.

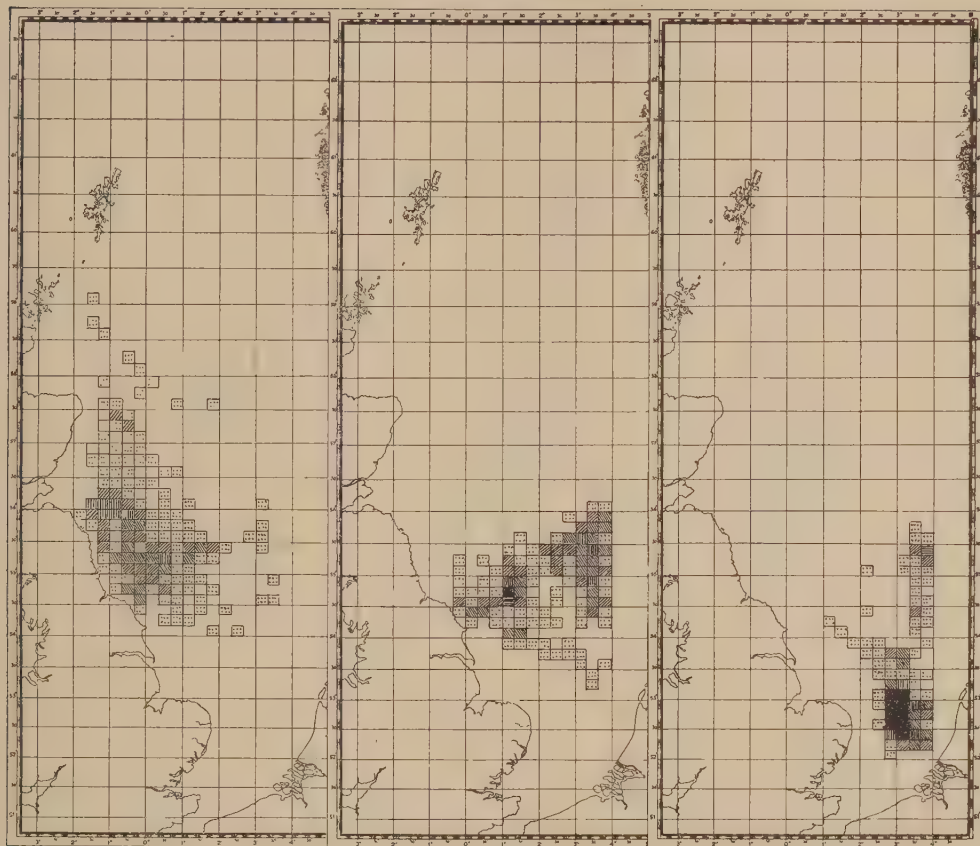
Drift-net fisheries.

The number of vessels which give information on the area and quantity of the catches is still increasing. This year data could be used from a number of vessels covering about 80 % of the activity of the whole lugger fleet. The Charts 1—24 give the results. The number of nets rose gradually from 60 at the start of the season to 100 in the second half of June, and remained 100 in the other months. The nets were set either for surface or for deeper water fishing.

The distribution of the fleet shows differences with 1951, especially in the first three months. These differences are correlated with differences in the distribution of the herring.

In May-July 1952 the catches were better than the previous year, and more concen-

Number of Shots.

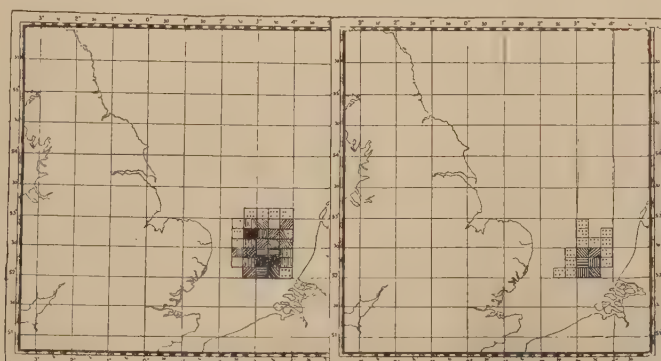


Charts 4—6.

August

September

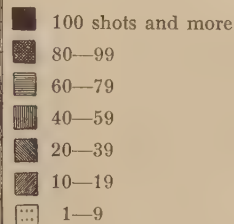
October



Charts 7—8.

November

December

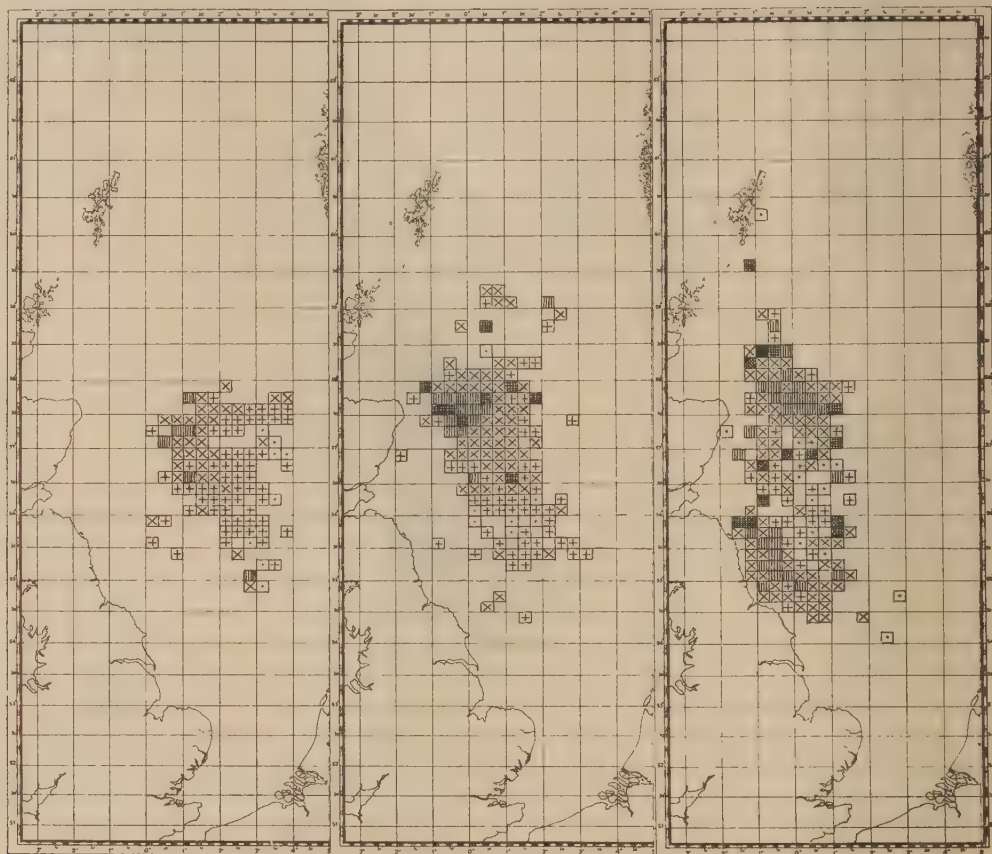


trated, in the area between 57° — 58° N. and 1° W.— 1° E.

In the Shields area (July-August) the main fishery was nearer to the coast.

In October 1952 the catches were much above those of the corresponding month in 1951, but below in November and December.

Mean Catch per Shot (in Kantjes).



Charts 9—11.

May

June

July

It is a striking phenomenon that the proportion of spent herring in the catches was much higher in 1952 than in 1951, as can be seen from the Charts 17—24. Table 15 A gives the total quantity of drift-net herring landed.

The total weight of herring landed by the drift-net fisheries was 90,205 tons.

J. DE VEEN.

Trawl fisheries.

The Charts 25—28 refer to the catch of herring per 100 hours fishing by the Dutch steam trawlers fishing with the herring trawl.

In July and August the Fladen area gave higher catches than the year before. The mean

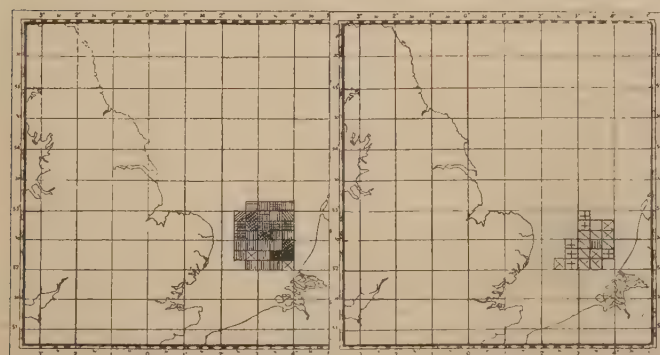
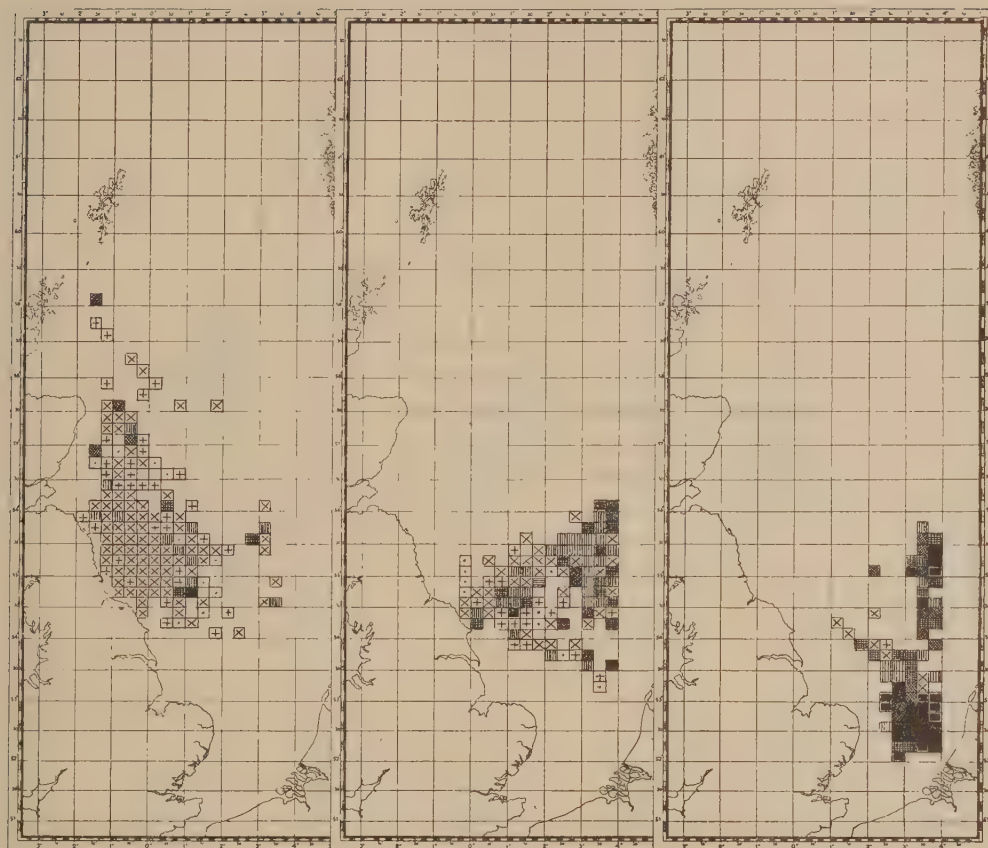
catches in September and October were about equal to those in the corresponding months of 1951.

Table 15 B gives the quantity of herring landed by the trawlers and by the whole fleet fishing with trawl-nets. The table shows that in some months other than those given in the charts, considerable quantities of herring have also been landed by the trawlers. The details of these months could not be given in charts because it was impossible to separate the fishing trips with the herring trawl and with the ordinary otter-trawl.

The total quantity landed was nearly equal to that in 1951.

L. K. BOEREMA

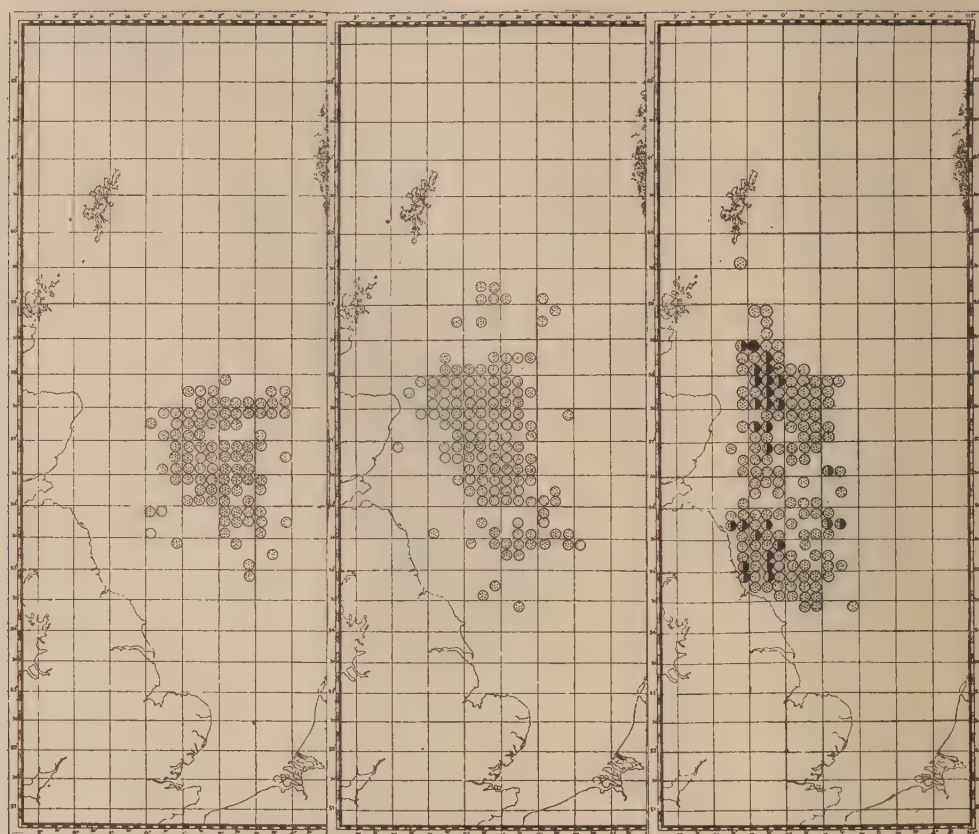
Mean Catch per Shot (in Kantjes).



Mean Number of Kantjes per Shot



Sorting.



Charts 17—19.

May

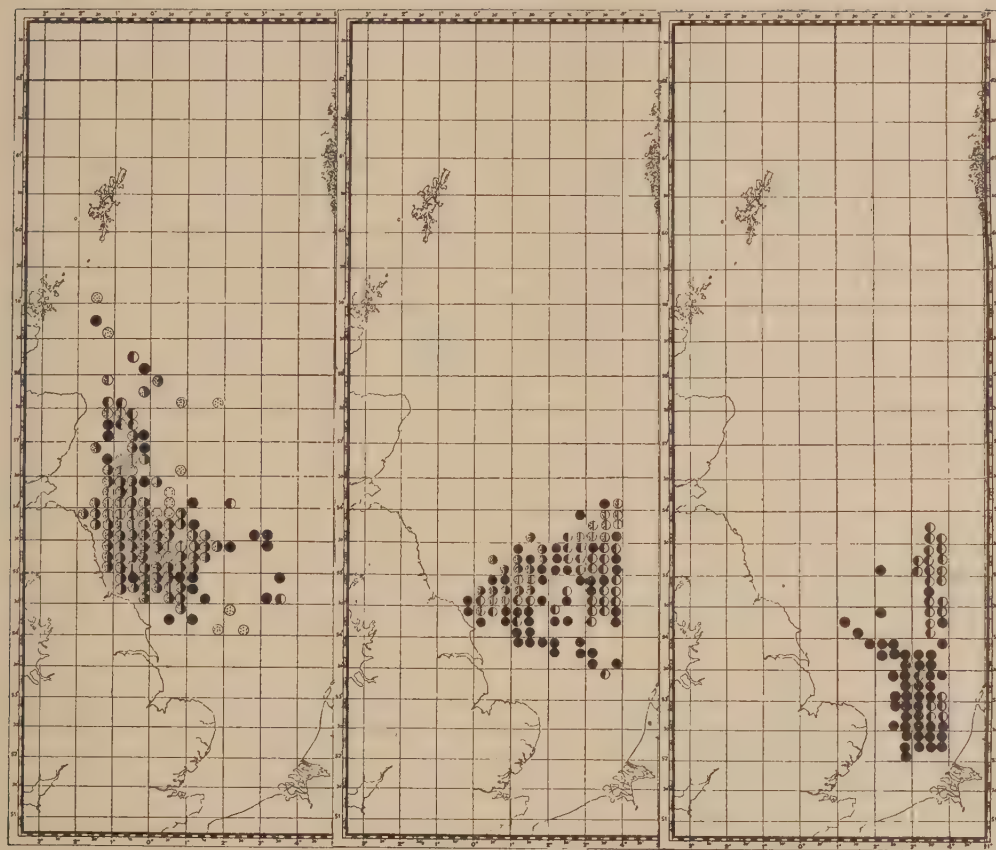
June

July

Table 15. Quantities of Herring landed in Dutch Ports in 1952.

Month	A. Landed by the Luggers fishing with Drift-Nets.				B. Trawled Herring (in tons).	
	Salted herring (in kantjes of 94 kg.)				Trawlers	All kinds of vessels
	Matjes	Gutted Full	Spent	Ungutted		
January.....	—	3	11	421	35	71
February.....	—	—	—	—	650	781
March.....	—	—	—	—	1,070	1,875
April.....	—	—	—	—	91	193
May.....	1,808	—	—	—	90	92
June.....	83,178	—	—	2,640	86	91
July.....	103,157	637	—	3,051	2,578	3,486
August.....	24,526	5,763	1,053	128	4,060	13,314
September.....	9,001	41,138	4,432	19,042	5,520	13,294
October.....	597	26,303	6,084	263,094	3,806	6,127
November.....	—	1,701	858	136,862	1,273	1,427
December.....	—	213	773	59,004	1,471	2,241
Total 1952.....	222,267	75,758	13,211	484,242	20,730	42,992

Sorting.



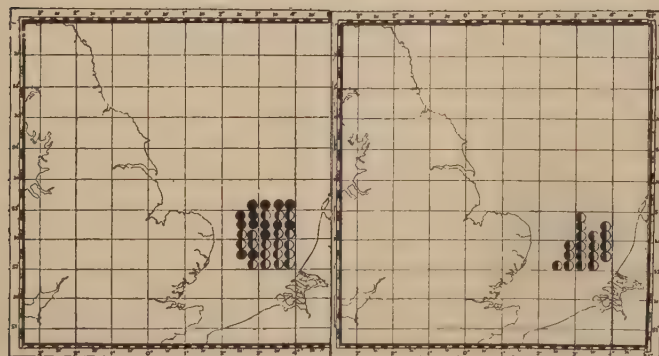
Charts 20—22.

August

September

October

Sorting.



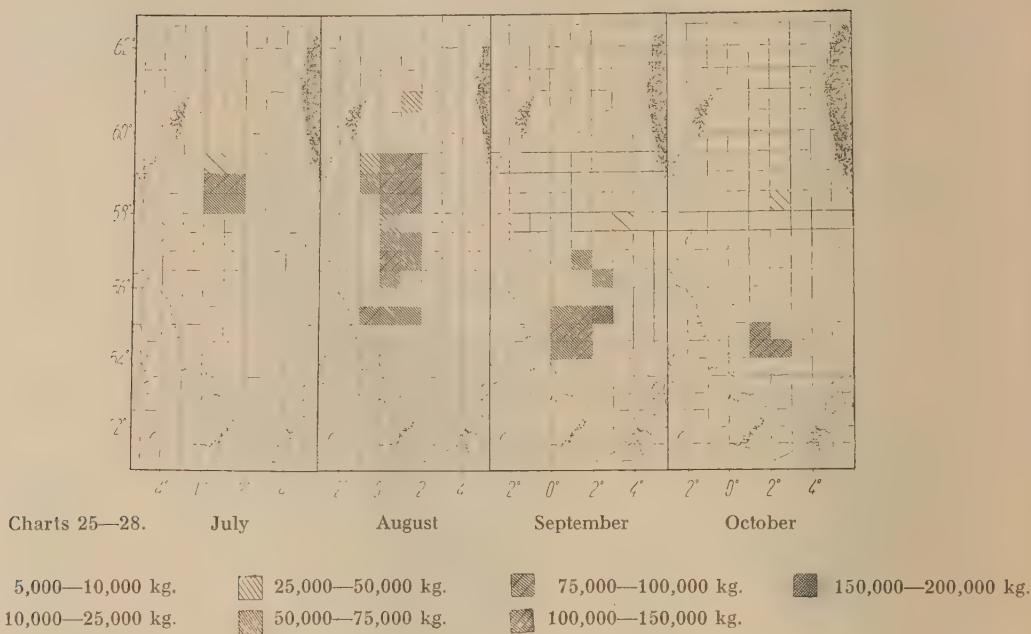
Charts 23—24.

November

December

- Matjes
- Full
- Matjes and Full
- Full and Spent
- Matjes, Full and Spent

Dutch Catches of Trawled Herring per 100 Hours Fishing.



Full-Herring Concentrations exploited by the Belgian Herring Trawlers in 1952.

A. Activity — Landings — Value.

The first full-herring catches were landed on 16. July and the last ones on 20. December. As usual, the Belgian full-herring fishery in the North Sea moved from north to south, starting in the Fladen Ground area and finishing in the Straits of Dover. During July and August, all but a few catches were from the northern area, with the Fladen Ground as centre. During September and October, the herring trawlers were mainly active in the central area, viz. the Old Devil Hole, Eastern Hole, Gut and Bruceys Garden. During November, the fishery moved to the southern area of the North Sea, where most of the catches were made around the "Sandettié" and "Ruytingen" lightships.

The activity of the herring fleet during 1952 was about the same as during 1951. Although the number of active trawlers and the number of catches showed a considerable increase — 53 trawlers against 37 and 296 catches against 215, the number of H. P. developed-fishing hour increased but slightly: 6,280,209 against 6,277,371.

The total seasonal landings were 6,529 tons full herring against 5,794 tons in 1951, an increase of 12.68 %.

The average catch per voyage underwent a considerable decrease in 1952, 22 tons against 27 tons in 1951, 18.15 % less.

On the other hand, the average catch per 100 H. P. developed-fishing hour showed a remarkable increase, i.e., 104 kg. against 92 kg. in 1951, or 13.04 %. The increase of this average denotes that an equal effort produced by the trawlers gave a better output than in 1951. From this we may infer that the herring concentrations exploited by the Belgian herring trawlers during 1952, were somewhat denser than in 1951. This is true for the three fishing grounds.

The seasonal value reached 20.2 mill. fr. against N. 21.6 mill. fr. in 1951, or 6.29 % less.

B. Biology.

The material studied comprises 11 samples with a total of 1,100 herrings; 200 from the northern area and 900 from the central area of the North Sea. The samples from the northern area came from the Fladen Ground; those from the central area from the Old Devil Hole, the Eastern Hole and Bruceys Garden.

Table 16. Number of Belgian Herring Trawlers (T), of Voyages (V), of Sea-Days (S.D.) and of Effective Fishing Hours (F.H.)

according to Classes of Vessels and Fishing Grounds.

North Sea Fishing Grounds and Months	Class III		Class IV		Class V		Class VI		Total		Class II		Class III		Class IV		Class V		Class VI		Total	
	T	V	T	V	T	V	T	V	T	V	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.	S.D.	F.H.
North Sea, North																						
July.....	—	—	4	4	5	7	5	6	14	17	—	—	—	—	53	564	76	830	55	619	184	2,013
August.....	1	1	6	9	8	10	5	5	20	25	—	—	15	34	106	1,347	113	1,306	50	546	284	3,233
November .	—	—	—	—	—	—	1	1	1	1	—	—	—	—	—	—	—	—	14	87	14	87
Total.....	1	1	8	13	8	17	5	12	22	43	—	—	15	34	159	1,911	189	2,136	119	1,252	482	5,333
North Sea, Central																						
August....	2	3	1	1	2	2	2	3	7	9	—	—	30	136	11	147	27	399	20	207	88	889
September .	—	—	6	13	8	13	4	8	18	34	—	—	—	—	89	850	97	999	53	571	239	2,420
October....	—	—	5	10	8	17	3	7	16	34	—	—	—	—	80	692	122	1,049	50	425	252	2,166
November .	—	—	—	—	—	—	1	1	1	1	—	—	—	—	—	—	—	—	12	120	12	120
Total.....	2	3	7	24	8	32	4	19	21	78	—	—	30	136	180	1,689	246	2,447	135	1,323	591	5,595
North Sea, South																						
October....	5	8	1	2	—	—	—	—	6	10	—	—	20	177	7	93	—	—	—	—	27	270
November .	24	127	5	21	2	6	2	4	36 ¹⁾	161 ¹⁾	4	17	422	3,460	67	606	21	136	21	147	535	4,366
December..	—	—	—	—	1	1	1	3	2	4	—	—	—	—	—	—	9	31	21	96	30	127
Total.....	24	135	5	23	3	7	2	7	37 ¹⁾	175 ¹⁾	4	17	442	3,637	74	699	30	167	42	243	592	4,763
Seasonal Total	24	139	12	60	9	56	5	38	53 ¹⁾	296 ¹⁾	4	17	487	3,807	413	4,299	465	4,750	296	2,818	1,665	15,691

¹⁾ Including 3 T & V of Class II.

The former area was fished during July and August and the latter during August, September and October.

During 1952, the average length of the herring was: —

	Northern area	Central area	Both areas
In 1952	287 mm.	264 mm.	268 mm.
In 1951	276 »	261 »	267 »

The average length increased slightly in the two areas. The average weight is also somewhat higher, 170 g. against 162 g.

From July to September most herrings were of maturity stage V and from October of stage VI.

The first group (herrings with maturity stages I to III) represented only 12.5 % of the total against 20.3 % in 1951.

The order of frequency of the year-classes is as follows: —

Year-Class	1944	1948	1949	1947	1945
Age (years)	6	4	3	5	7
Percentage	20.1	14.8	14.6	13.5	12.6

The percentages of the older year-classes vary between 4.5 and 6.2 %. The four youngest year-classes totalize 63.0 % against 68.2 % in 1951.

The average number of vertebrae for the

herrings of the first group is abnormally low: 56.51 against 56.81 in 1951, whereas the average for the second group (maturity stages IV to VIII-II) is slightly higher: 56.52 against 56.51.

The average number of keeled scales (K_2) observed for the herrings of the first group is lower than that for the second group: 14.58 against 14.71, this may be considered as a normal result.

Among the 1,100 stomachs examined only 92, or 8.4 %, were found to have some contents: 56, or 5.1 %, full; 30, or 2.7 %, half-full and 6, or 0.6 %, a quarter-full.

The contents observed consisted for the greater part of remains of copepods and smaller quantities of schizopods.

Table 17. Total Seasonal Weight in 1952.

	Weight (Tons)	Percentage
Full herring.....	6,528.8	93.16
Spent herring.....	3.6	0.05
Mackerel.....	209.1	2.98
Horse mackerel.....	3.0	0.04
Sprat.....	0.6	0.01
Demersal fish.....	262.4	3.74
Shellfish and molluscs...	1.2	0.02
Total.....	7,008.8	

Table 18. Total Weight landed (in Tons) and the Average Catch per Voyage (C/V) in Tons and per Hour per 100 H.P. (C/H) (in Kg.).

Origin Months	Number of tons						Class II		Class III		Class IV		Class V		Class VI		Total	
	Class II	Class III	Class IV	Class V	Class VI	Total	C/V	C/H	C/V	C/H	C/V	C/H	C/V	C/H	C/V	C/H	C/V	C/H
North Sea, North																		
July.....	—	—	62	242	459	763	—	—	—	—	16	34	34	71	77	92	45	75
August.....	—	8	344	371	436	1,159	—	—	8	132	38	73	37	71	87	97	46	79
November..	—	—	—	—	38	38	—	—	—	—	—	—	—	—	37	57	37	57
Total.....	—	8	406	613	933	1,960	—	—	8	132	31	62	36	71	78	92	46	77
North Sea, Central																		
August.....	—	31	26	68	164	288	—	—	10	125	26	55	34	41	55	100	32	72
September..	—	—	447	647	591	1,686	—	—	—	—	34	152	50	160	74	131	50	146
October....	—	—	343	521	419	1,283	—	—	—	—	34	139	31	122	60	129	38	128
November..	—	—	—	—	20	20	—	—	—	—	—	—	—	—	20	22	20	22
Total.....	—	31	816	1,236	1,194	3,277	—	—	10	125	34	139	39	124	63	116	42	124
North Sea, South																		
October....	—	45	13	—	—	58	—	—	6	141	6	51	—	—	—	—	6	102
November..	4	714	150	71	155	1,093	1	221	6	116	7	87	12	116	39	140	7	114
December..	—	—	—	16	125	141	—	—	—	—	—	—	16	128	42	173	35	166
Total.....	4	759	163	87	280	1,292	1	221	6	118	7	83	12	118	40	153	7	117
Seasonal Total	4	798	1,385	1,936	2,407	6,529	1	221	6	118	23	96	35	100	63	108	22	104

Table 19. Full Herring. Length, Weight, Sex, Maturity, Fat Content, and Age (Percentages).

A. Centimetre Class, Mean Length (cm.), Average Weight (gr.), and Sex (Percentages).

Origin	Centimetre Classes												Aver. Males	
	20	21	22	23	24	25	26	27	28	29	30	31	Mean Weight	%
North Sea, North	—	—	—	—	—	1.0	4.5	20.0	30.5	31.0	11.5	1.5	28.7	210 64
North Sea, Central	0.1	0.2	1.6	9.8	13.7	14.0	16.6	20.0	17.2	6.4	0.4	—	26.4	161 50
Total.....	0.1	0.2	1.3	8.0	11.2	11.6	14.4	20.0	19.6	10.9	2.5	0.3	26.8	170 52
1. group.....	0.7	0.7	7.2	30.4	19.6	8.0	10.9	12.3	3.6	4.4	2.2	—	25.1	132 39
2. group.....	—	0.1	0.4	4.8	10.0	12.2	14.9	21.1	21.9	11.8	2.5	0.3	27.1	176 54

B. Stages of Maturity and Quantity of Mesenteric Fat.

Origin	Stages of Maturity								Quantity of Fat				
	1. group (138 herring)				2. group (962 herring)				0	1	+	M	
North Sea, North..	2.5	3.5	10.5	32.5	51.0	—	—	—	15.0	37.0	28.0	20.0	
North Sea, Central..	2.7	2.4	6.6	14.8	38.3	29.3	0.9	5.-	24.6	40.0	23.0	12.4	
Total.....	2.6	2.6	7.3	18.0	40.6	24.0	0.7	4.1	22.8	39.5	23.9	13.8	
1. group.....	21.0	21.0	58.0	—	—	—	—	—	0.7	1.5	15.9	81.9	
2. group.....	—	—	—	20.6	46.5	27.4	0.8	4.7	26.0	44.9	25.0	4.1	

C. Distribution of Year-Classes and Age-Groups.

Number of Herrings with readable scales: 562.									
Winter-Rings....	2	3	4	5	6	7	8	9	+
Age (Years).....	3	4	5	6	7	8	9	10	+
Year-Classes....	1949	1948	1947	1946	1945	1944	1943	1942	Before '42
Northern.....	0.9	6.7	8.4	15.1	12.6	15.1	8.4	11.8	21.0
Central.....	18.3	16.9	14.9	21.5	12.6	3.8	3.4	4.1	4.5
Total.....	14.6	14.8	13.5	20.1	12.6	6.2	4.5	5.7	8.0
1. group.....	28.2	28.2	12.8	12.8	12.8	2.6	2.6	—	—
2. group.....	13.6	13.8	13.6	20.6	12.6	6.5	4.6	6.1	8.6

Table 20. Full Herring. Average Length and Average Value of L_1 of each Year-Class.

Length of Year-Classes, mm.											L ₁ of Year-Classes, in mm.										
Born in:.....	1949	48	47	46	45	44	43	42	Bef. 42	Total	49	48	47	46	45	44	43	42	Bef. 42	Total	
Age:.....		3	4	5	6	7	8	9	10	10+											
North Sea, North . . .	265	274	278	280	285	289	293	293	298	288	111	125	113	111	118	125	124	123	123	120	
North Sea, Central . .	245	259	271	276	282	287	288	288	288	269	114	111	117	108	113	114	107	125	100	112	
Total.....	245	261	272	277	283	288	290	290	294	273	114	112	117	109	114	119	114	124	113	114	
1. group.....	240	254	271	276	289	283	296	—	—	261	110	113	112	103	123	106	113	—	—	112	
2. group.....	245	262	272	277	282	288	289	290	294	274	114	112	117	109	113	120	114	124	113	114	

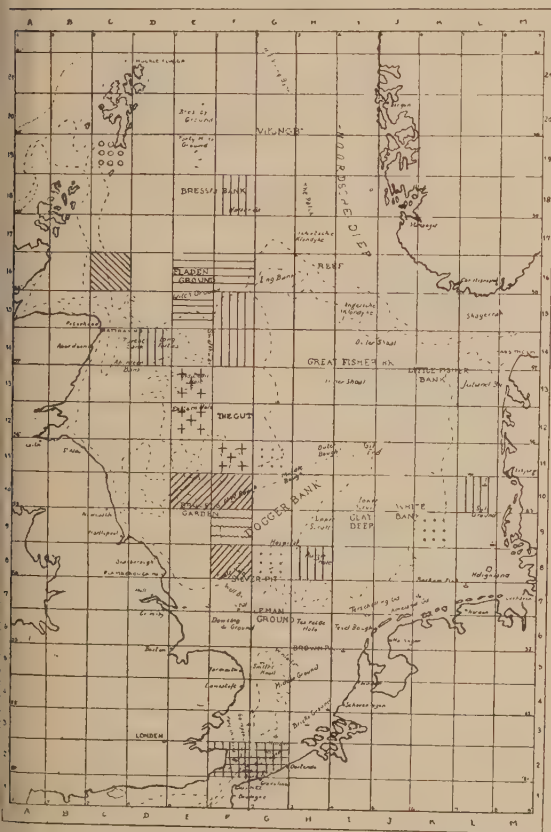


Figure 15. Fishing grounds exploited by Belgian herring trawlers in 1952.

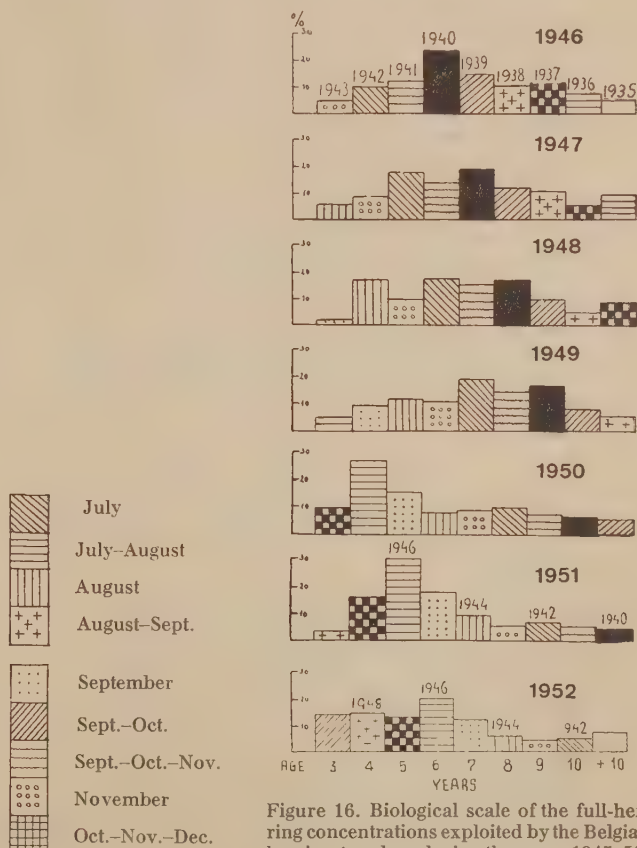


Figure 16. Biological scale of the full-herring concentrations exploited by the Belgian herring trawlers during the years 1947-52.

Table 21. Full Herring. Racial Characters. Percentage Distribution and Means.

	Number of Vertebrae ¹⁾								Number of K ₂								
Origin	52	54	55	56	57	58	59	Average	12	13	14	15	16	17	18	19	Average
North Sea, North	0.5	—	4.8	50.5	39.9	4.3	—	56.41	0.5	8.5	36.0	40.0	12.5	2.5	—	—	14.63
North Sea, Central	—	0.1	4.5	43.6	44.8	6.5	0.5	56.54	0.2	6.8	32.6	45.2	12.9	2.0	0.1	0.2	14.71
Total.....	0.1	0.1	4.5	44.9	43.9	6.1	0.4	56.52	0.3	7.1	33.2	44.2	12.8	2.1	0.1	0.2	14.70
1. group.....	—	—	6.1	43.9	43.2	6.1	0.7	56.51	1.5	12.6	31.1	40.8	11.1	2.2	—	0.7	14.58
2. group.....	0.1	0.1	4.4	45.0	44.0	6.1	0.3	56.52	0.1	6.4	33.5	44.7	13.0	2.1	0.1	0.1	14.71

¹⁾ The census for the vertebrae covered 1,100 spines, of which there were 48, or 4.4 %, with one or more fused vertebrae. These spines have been eliminated from our material.

C. Forecasts for the full-herring campaign 1953.

Based on the age composition of the catches in which the four youngest classes (3 to 6-year-olds) were exceptionally well represented by 68.2 %, we had forecast dense herring concentrations for 1952. These forecasts were largely confirmed, as the average catch per 100 H. P. developed-fishing hour increased to 104 kg. in 1952 against only 92 kg. during 1951.

With regard to the prospects for the probable density of the herring concentrations in 1953, the fact must be taken into account that the percentage of the four youngest classes in 1952, viz. 63.0 %, was slightly lower than in 1951. However, the youngest year-class 1949 (three-year-old herrings) is very well represented in the age distribution with the high percentage of 14.6 %. This is considered to be of good omen for the coming seasons.

Thus, we are of the opinion that, if the hydrological conditions of the sea do not hinder the concentration of the herring shoals and if the weather conditions do not prevent the normal activity of the herring trawlers, the herring season 1953 may prove also to be a satisfactory one.

CH. GILIS.

Spent-Herring Concentrations on the Belgian and French Coasts, 1952—53.

A. Fishery.

I. Period, Fishing Grounds and Methods.

The spent-herring campaign 1952—53 lasted only two months, December and January. In comparison with the previous years it was of very short duration. The number of days of sale was also brought to a minimum:— 23 in December and 26 in January, or a total of 49 against 61 during the season 1951—52.

Dense spent-herring concentrations were very rare in the French and Belgian territorial waters. The Belgian catches were mainly fished within an area, the north side of which extends from the lightship "Sandettié" to the north of the West-Hinder Bank and the south side

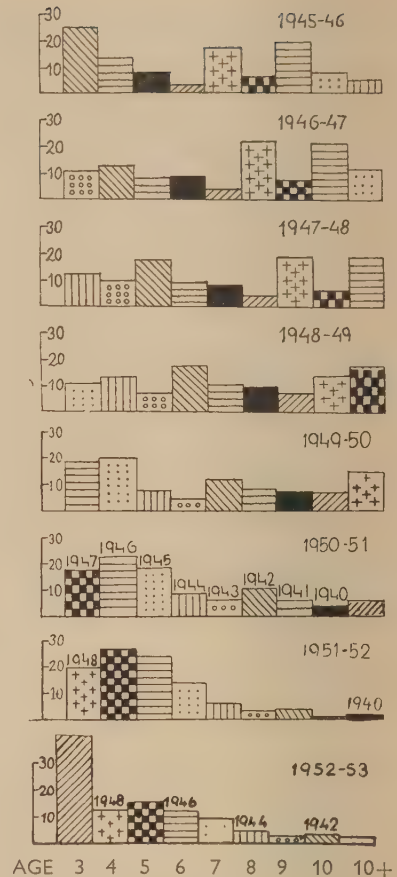


Figure 16 A. Biological Scale of the Spent-Herring Concentrations during the winters 1945/6 to 1952/3.

from the lightship "Dyck" to the buoy east of the Kwinte Bank.

For the first time, the spent-herring fishery was exclusively done with the "bull-net" and the pelagic herring trawl universally used. As the fishermen totally abandoned the use of the "otter-trawl", the "bull-net" method must undoubtedly be the most efficient method for this fishery.

Table 22. Spent Herring. Number of Voyages and Catch.

Classes of Vessels	Number of Voyages					Total Weight landed in tons					Average Catch (kg.) per fishing day/H.P.				
	I	II	III	IV	Total	I	II	III	IV	Total	I	II	III	IV	Total
December. . .	35	88	295	58	476	71	241	1937	391	2640	32.6	30.5	37.9	29.5	35.4
January. . . .	18	82	425	121	646	47	273	2448	722	3490	37.1	36.2	33.5	25.1	31.5
Total.	53	170	720	179	1122	118	514	4385	1113	6130	34.2	33.3	35.3	26.5	33.1

Table 25. Percentage Distribution of Vertebrae.

Month				Number of Vertebrae					Average
	52	53	54	55	56	57	58	59	
December.....	0.3	—	0.6	2.8	43.9	46.4	6.0	—	56.530
January.....	—	—	—	2.3	38.0	51.8	7.6	0.3	56.655
Total.....	0.2	—	0.3	2.6	40.8	49.1	6.8	0.2	56.594

B. Biology.

The material comprised 6 samples totalling 674 herrings. Of these, 324 were collected and analysed in December 1952 and 350 in January 1953.

The census for the vertebrae covered 674 spines, of which there were 5, or 0.7 %, with one or more fused vertebrae and 8, or 1.2 %, with damaged vertebrae. These 13 spines have been eliminated from our material. The marked increase in the number of vertebrae during January is most probably due to the large presence of "Channel herring" during this month.

Among the 674 stomachs examined, only 65, or 9.6 %, were found to have some contents, which for the greater part consisted of remains of copepods.

C. Forecasts for the campaign 1952-53.

The extreme prominence of the youngest year-classes in the catches of 1952—53 is a very good sign for the future spent-herring concentrations. It must be assumed that the marked decrease of the average catch per voyage for 1 H.P., which was found during last season, is not so much to be ascribed to the overfishing of the herring stock, but rather to the fact that the spent-herring shoals were only to be found at a great distance from the coast and that they were scattered over a vast area. The exceptionally rich contingent of three-year-old herrings, which took part for the first time in the reproduction, confirms this opinion in a large measure.

The results of the spent-herring season 1953—54 will depend mainly upon the hydrological and meteorological conditions which may prevail during the campaign.

CH. GILIS.

Hareng du Sud de la Mer du Nord et de la Manche Orientale, Campagne de 1952—53.**I. Déplacements de la pêcherie. Rendements.**

La campagne de pêche s'est ouverte cette année plus tôt que de coutume puisque les

chalutiers de Boulogne ont commencé à pêcher le hareng plein sur le Sandettié dès le 18 Octobre. Ces premières pêches ont été assez bonnes: pour les grands et moyens chalutiers les apports étaient de 20 tonnes environ par sortie de 24 heures.

En Novembre la pêche s'est poursuivie avec quelques différences notables par rapport aux années précédentes. En effet les grandes concentrations de poissons aux stades V et VI, habituellement observées pendant plusieurs semaines dans la région située au sud du banc Sandettié, ne se sont maintenues que très peu de temps en cet endroit et l'on a assisté à une série d'allées et venues des chalutiers recherchant les concentrations de harengs au moyen du sondeur à ultra-sons. Au cours de ces déplacements les chalutiers ont successivement fréquenté les régions du Sandettié, du Vergoyer et de l'Ailly.

L'importance des rendements n'a guère dépassé la moyenne (20 à 40 tonnes par sorties de 2 à 4 jours) sauf durant une courte période où des bancs de harengs d'une grande densité se sont concentrés sur le Vergoyer (entre le 14 et le 17 Novembre; tonnages: 90 à 140 tonnes par sorties de 24 à 48 heures). Tout à fait à la fin du mois de fortes pêches ont également eu lieu sur les fonds de l'Ailly.

En Décembre les lieux de pêche les plus fréquentés ont continué à être le Sandettié (et surtout la région située à l'ouest du banc, vers 51°10' L.N. et 1°40' E.G.) et la partie occidentale de la région dite de l'Ailly (vers 50°20' L.N. et 0°25' E.G.). Comme en Novembre la pêche fut gênée par le mauvais temps.

Au cours du mois de Décembre, après quelques bonnes pêches faites la première semaine dans la région de l'Ailly, les rendements sont allés constamment en décroissant et l'on peut dire que la campagne a pratiquement pris fin dans les derniers jours de Décembre.

Quelques chalutiers ont encore continué à pêcher (hareng guai) en Janvier, dans les parages du North Hinder et du West Hinder, puis en Février, dans la région du Silver Pit.

En résumé la campagne de pêche du hareng a été caractérisée cette année par son début

précoce et surtout par la grande instabilité des concentrations. En particulier les concentrations de harengs au stade de ponte, ou voisin de la ponte, ne sont pas restées groupées comme les années précédentes dans la région bien délimitée du «creux» du Sandettié, au sud de ce banc. Les patrons de chalutiers, contraints à de constants déplacements, ont fait usage des sondeurs à ultra-sons pour la recherche des bancs de harengs.

A part quelques excellentes pêches réalisées pendant quelques jours sur le Vergoyer et dans la région de l'Ailly, les rendements furent dans l'ensemble moyens.

II. Conditions hydrologiques.

Les salinités et températures suivantes ont été relevées sur les lieux de pêche ou à proximité (observations faites à bord de chalutiers).

Date	Position	Profondeur	Salinité	Température
18/11/52.....	50° 37' L.N., 1° 19' E.G.	surface	34.72 ‰	10.8°
18/11/52.....	51° 08' L.N., 1° 36' E.G.	surface	34.79 ‰	11.2°

III. Composition du stock.

La répartition par classes d'âge (Figure 17) montre l'existence d'une classe de harengs de 3 ans très importante (27.8 %) dépassant largement le double du pourcentage normal (12.3 %)¹). Les classes des harengs de 4, 5 et 6 ans sont déficitaires, notamment les deux premières (17.8 % au lieu de 26.2 % pour les harengs de 4 ans et 13.1 % au lieu de 25.8 % pour les harengs de 5 ans). Les vieilles classes (7 à 11 ans) sont plus ou moins proches de la moyenne.

Depuis deux ans déjà (campagnes 1950/51 et 1951/52) nous avons attiré l'attention sur la présence anormalement régulière depuis 1948, dans le stock étudié chaque année, d'une abondante classe de jeunes harengs de 3 ans apparaissant pour la première fois sur les frayères — classe dont l'importance s'efface l'année suivante.

Le même phénomène se produit, une fois de plus, cette année: d'une part, comme nous venons de le voir, la classe 1949 (harengs de 3 ans) peut être considérée comme très importante; d'autre part la classe 1948 qui l'année dernière (harengs de 3 ans) atteignait

¹) Nous nous basons, pour ces comparaisons, sur les moyennes établies d'après le stock d'avant-guerre étudié par J. LE GALL (1926—37).

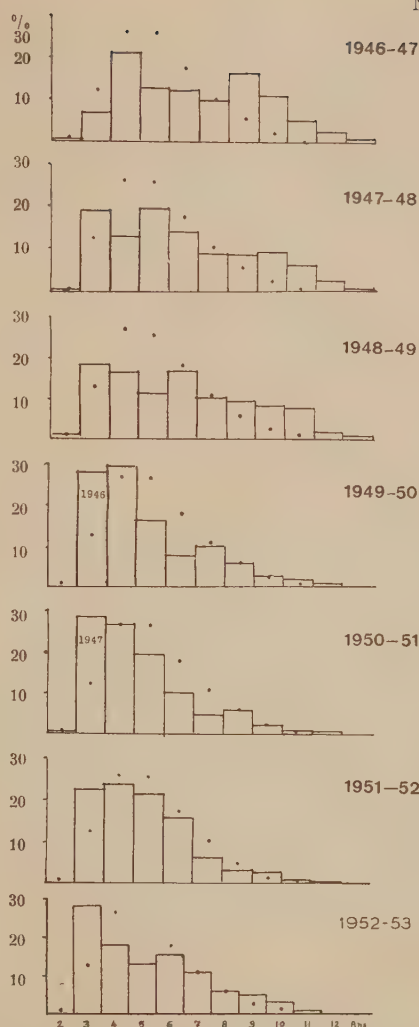


Figure 17. Hareng du sud de la Mer du Nord et de la Manche Orientale. Composition du stock.

23.1 % du stock — c'est à dire presque le double du pourcentage normal — est tombée cette année (harengs de 4 ans) à 17.8 %, c'est à dire à 8 % au dessous du pourcentage normal.

De même la classe 1947 atteignant au début de la période d'observations (harengs de 3 ans) une valeur dépassant nettement le double du pourcentage normal, représentait la seconde année (harengs de 4 ans) 24.3 % du stock — valeur un peu au dessous du pourcentage normal (26.2 %) — puis la troisième année (harengs de 5 ans) 13.1 % du stock seulement — valeur nettement au dessous du pourcentage normal (25.8 %).

Nous avons expliqué l'année dernière (Ann. Biol., Vol. VIII (1951) p. 165—166) comment le pourcentage élevé des harengs de 3 ans constaté invariablement chaque année dans la composition du stock et le fait que cette forte proportion de harengs de 3 ans ne déterminait pas, pour autant, l'année suivante, une forte proportion de harengs de 4 ans, conduisaient à admettre l'hypothèse d'une influence de la pêche sur le stock.

La composition du stock de harengs du sud de la Mer du Nord et de la Manche Orientale enregistrée cette année ne fait que confirmer une telle hypothèse.

IV. Données biométriques.

a) Taille et âge.

La relation taille/âge pour l'ensemble du stock étudié en 1952/53 résulte du Tableau 27.

Si nous comparons ces données avec celles obtenues au cours des précédentes années (depuis 1945) et avec celles obtenues par J. LE GALL sur les mêmes populations de harengs entre 1933 et 1937 nous constatons que la taille des harengs du même âge a sensiblement augmenté. Ce phénomène exprimé dans la Figure 18 est particulièrement net à partir de 1950. Actuellement on peut dire que la moyenne des tailles des harengs de 3, 4 et 5 ans *a augmenté de 1 cm. à 1.5 cm.* par rapport à la moyenne établie avant la guerre, entre 1933 et 1937. La moyenne des tailles des harengs de 6 et 7 ans *a augmenté de 1 cm.* environ.

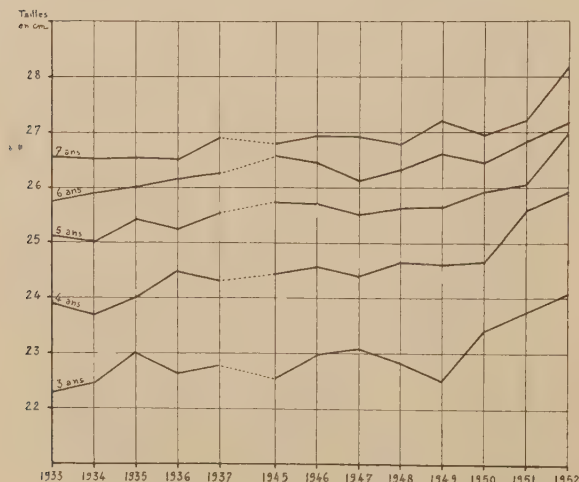


Figure 18. Relation taille/âge.

Tableaux 26—29.

Hareng du sud de la Mer du Nord:

Sandettié et Banes de Flandre;

Hareng de la Manche Orientale:

Vergoyer et Ailly.

Tableau 26. Taille.

(Ensemble du stock. Taille calculée au millimètre, l'addition de 0.25 cm. donne la moyenne vraie).

cm....	22	23	24	25	26	27	28	29
Nombre	17	82	115	99	173	199	130	23
%.....	2.0	9.7	13.7	11.8	20.6	23.7	15.5	2.8

Tableau 27. Taille et Age.

(Ensemble du stock. Taille calculée au millimètre).

Hareng de 3 ans,	24.09 cm.,	de 4 ans,	25.89 cm.,
» » 5 »	27.00 cm.,	» 6 »	27.22 cm.
» » 7 »	28.21 cm.		

Tableau Général de la Relation Taille/Âge: 1933—1951.

(Ensemble du stock: Sud de la Mer du Nord et Manche Orientale).

Année/Âge	3	4	5	6	7
1933... cm.	22.31	23.88	25.12	25.74	26.54
1934... »	22.45	23.69	24.99	25.88	26.52
1935... »	23.02	24.02	25.42	26.01	26.55
1936... »	22.63	24.48	25.27	26.15	26.49
1937... »	22.78	24.33	25.55	26.24	26.89
1945... »	22.56	24.47	25.73	26.59	26.80
1946... »	23.01	24.63	25.72	26.46	26.93
1947... »	23.11	24.42	25.51	26.12	26.92
1948... »	22.84	24.65	25.66	26.31	26.80
1949... »	22.50	24.60	25.67	26.63	27.20
1950... »	23.44	24.65	25.97	26.46	26.96
1951... »	23.73	25.62	26.07	26.86	27.23

Tableau 28. Moyenne Vertébrale.

Nombre de vertèbres	A. Sud de la Mer du Nord (Sandettié)		B. Manche Orientale	
	Fréquence	%	Fréquence	%
53	1	0.4	—	—
54	1	0.4	—	—
55	19	6.5	7	4.2
56	111	38.4	69	41.5
57	144	49.8	82	49.3
58	13	4.6	8	4.8
Moyenne	56.50		56.55	

Tableau 29. Age.

(Ensemble du stock).

Classe	Age	No.	%	Classe	Age	No.	%
1950.....	2	1	0.1	1944...	8	48	5.9
1949.....	3	227	27.8	1943...	9	40	4.9
1948.....	4	145	17.8	1942...	10	26	3.2
1947.....	5	107	13.1	1941...	11	5	0.6
1946.....	6	128	15.7	1940...	12	1	0.1
1945.....	7	88	10.8				

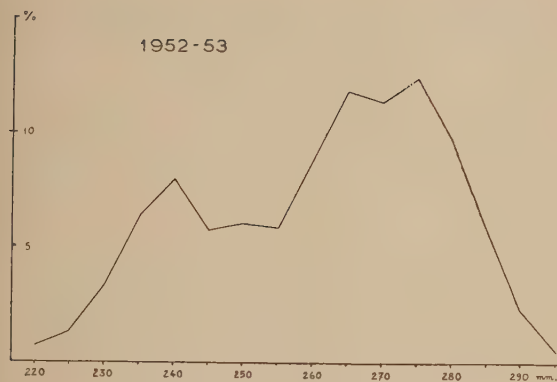


Figure 19. Courbe de répartition des tailles.

On sait que l'augmentation de la taille en rapport avec l'âge, traduisant une accélération de la croissance, est un phénomène couramment enregistré dans le cas d'appauvrissement quantitatif d'une espèce dans une région donnée et qui est attribué à la diminution de la concurrence vitale entre les individus de cette espèce.

b) Courbe de répartition des tailles.

La courbe de répartition des tailles (Figure 19) montre deux sommets: l'un à 240 mm. déterminé par l'abondante classe de harengs de 3 ans, l'autre entre 265 et 275 mm. et se rapportant au reste du stock.

c) Moyenne vertébrale.

La moyenne vertébrale des populations étudiées est la suivante:—

Harengs du sud de la Mer du Nord,	56.50
» de la Manche Orientale,	56.55.

Ces chiffres ne comportent pas de remarque spéciale.

V. Conclusion.

Les observations faites au cours de la campagne de pêche du hareng dans le sud de la Mer du Nord et en Manche Orientale en 1952/53 appellent les constatations suivantes:—

1) Présence, comme les années précédentes, d'une classe anormalement abondante de harengs de 3 ans apparaissant pour la première fois sur les frayères.

2) Ce pourcentage élevé de la classe de harengs de 3 ans, observé chaque année, cesse de se manifester l'année suivante, c'est à dire dès que ces mêmes harengs ont atteint leur 4e année.

3) Comme les années précédentes valeur moyenne des rendements de la pêche, notamment si on les compare aux rendements enregistrés au cours de la guerre et après la guerre (1943—1946) et si l'on considère les progrès considérables intervenus récemment dans la technique de la pêche grâce à la détection des bancs de poissons par les sondeurs à ultra-sons.

4) Accroissement sensible de la taille en rapport avec l'âge, depuis 1950, — en d'autres termes accélération de la croissance: phénomène généralement considéré comme lié à une diminution de la concurrence vitale, par suite d'un appauvrissement quantitatif du stock.

Ces données confirment l'hypothèse d'une influence de la pêche sur le stock et conduisent implicitement à envisager le problème de l'*overfishing* du hareng: problème de la plus grande importance biologique et économique, déjà abordé par B. HAVINGA, W. C. HODGSON et H. WOOD¹⁾.

La constatation de l'*overfishing* du hareng (constatation chaque année moins douteuse) démontrerait, entre autres, que l'influence de prélèvements de pêche devenus suffisamment massifs peut s'étendre à des espèces qui jusqu'à une époque récente semblaient à l'abri d'une diminution quantitative marquée en raison de leur apparition saisonnière et en raison du caractère pélagique et de la densité de leurs bancs.

Il est à noter cependant que, parmi ces espèces, le hareng est précisément une de celles dont l'existence n'est que partiellement pélagique puisqu'il passe une partie de sa vie sur le fond, ou près du fond. C'est, en outre, une espèce à ponte démersale, fait d'autant plus important à considérer que la pêche des chalutiers dans le sud de la Mer du Nord et en Manche Orientale a lieu *au moment de la ponte* et sur les frayères mêmes, ce qui risque d'accroître les ravages dans des proportions considérables.

Enfin il n'est pas impossible que les progrès intervenus ces dernières années dans la technique de la pêche — notamment l'utilisation de sondeurs à ultra-sons pour la détection des bancs de poissons — aient dès à présent leur répercussion sur la composition du stock de harengs et soient pour une large part liés aux phénomènes que nous avons analysés.

J. ANCELLIN.

¹⁾ Rapp. et Proc.-Verb., vol. 128 (I), p. 18, pp. 36—38.

Full-Herring Concentrations at the "Smalls".**A. Fishery.**

The Belgian trawlers had, since 1939, completely abandoned the full-herring fishery of the "Smalls". During 1951, a few trawlers returned once again to this fishing ground, but as the catches were not very remunerative they soon left it to return to the North Sea full-herring fishery where the catches were much better. The fishery limited itself to 9 voyages, with a total of 533.9 tons herring.

However, during 1952, the full-herring fishery of the "Smalls" took a turn for the better and the fishery went on for over a month (16. August to 22. September). A total of 1,439,830 H. P. fishing hours were developed.

Table 30. Activity of the Trawlers.

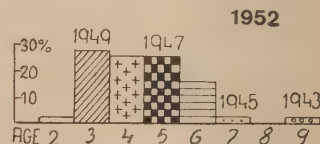
Number of Trawlers, Voyages, Sea-Days, and Fishing Hours.				
	T	V	S.D.	F.H.
Class IV...	1	2	16	116
» V....	6	14	136	1,412
» VI...	3	9	82	963
Total.....	10	25	234	2,491

Landings.			
	Tons landed	C/V (tons)	100 H. P. (C/H) (kg.)
Class IV...	106.6	53.3	306
» V....	717.1	51.2	125
» VI...	886.0	98.4	106
Total.....	1,709.7	68.4	127

Table 32. Relation between Length and Age.

Average Length in mm.									
Age	2	3	4	5	6	7	8	9	
Length	211	243	252	270	274	284	—	284	

Average Value of L ₁ in mm.									
Age	2	3	4	5	6	7	8	9	
Value of L ₁	148	117	114	126	110	105	—	144	

**Figure 20. Biological scale of the full herring concentration.****B. Biology.**

The material studied comprised three samples with a total of 230 herrings. The small number of herrings studied was caused by the fact that the herring fishery ended sooner than was expected.

C. Remarks.

Since the war, nothing has been published about the fishery and biology of the herring of the "Smalls". Because of this, nothing is known about the evolution during recent years of the full-herring fishery of the Smalls. Owing to lack of comparative material, it is not possible to deduce practical conclusions for the future herring campaigns based on the results of one single season.

Table 31. Full Herring. Length, Weight, Sex, Maturity, Fat Content, and Age (Percentages).**A. Centimetre Class, Mean Length (cm.), Average Weight (gr.), and Sex (Percentages).**

Centimetre Classes												
cm.....	19	20	21	22	23	24	25	26	27	28	29	30
%.....	0.4	0.9	2.6	6.1	9.6	16.5	20.0	21.7	16.1	5.7	—	0.4
												Mean
												25.5
												Aver. Weight
												144
												Males
												47

B. Stages of Maturity and Quantity of Mesenteric Fat.

Stages of Maturity							Quantity of Fat		
	I	II	III	IV	V	0	1	+	M
%.....	5.2	7.-	19.1	22.2	46.5	0.4	18.7	50.5	30.4

C. Percentage Distribution of the Year-Classes.

Number of herrings with readable scales: 55.

Age.....	2	3	4	5	6	7	8	9
Year Class.....	1950	1949	1948	1947	1946	1945	1944	1943
%.....	1.8	27.3	25.5	25.5	16.3	1.8	—	1.8

Table 33. Racial Characters.

Percentage Distribution

Number of Vertebrae.					
55	56	57	58	59	Average
3.9	29.1	53.8	12.8	0.4	56.77
Number of Keeled Scales (K_2)					
13	14	15	16	17	Average
6.1	42.6	41.8	9.1	0.4	14.55

If our fishermen keep up their interest in the full-herring fishery of the Smalls, regular observations will continue to be made and no doubt within a few years practical findings may be given to help the fishermen.

CH. GILIS.

Large Herring off the W. Coast of Jutland.

On the 19. March 1952 a remarkable catch of large herrings was obtained by a commercial cutter trawling north of the "Bløden" area on 56°00'N. 6°20'E.

On account of unfavourable weather conditions only one haul was made, which yielded 150 kg. of the large herring.

A sample of ca. 150 specimens was analysed and gave the results shown in Table 34.

Table 34.

Maturity: 80 % stage V, 20 % stage VI.

Length distribution			Age composition		
	No. of	Av.		Year-	No. of
cm.	spec.	weight	Rings	class	spec.
	%				%
					Aver.
					Size,
					cm.
30	2.3	205	4	1948	0.7
31	10.5	235	5	1947	74.8
32	25.6	260	6	1946	7.3
33	39.1	286	7	1945	5.3
34	15.8	314	8	1944	7.9
35	5.3	325	9	1943	1.3
36	1.5	—	10	1942	—
			11	1941	—
			12	1940	0.7
			13	1939	0.7
			14	1938	1.3

Meristic characters: $K_2 = 14.12$; V. S. = 57.04

Fat content: 4.7 %; average size: 33.3 cm.

The sample consists of spring spawners just about to spawn, with an average length of 33.3 cm. and 75 % belong to the 1947 year-class. Their V.S. amounts to about 57.0. In accordance with this, it seems reasonable to presume that they are strayers from the Norwegian stock. The fact that their spawning was somewhat delayed compared with this stock could be due to their aberrant migration.

E. BERTELSEN and K. POPP MADSEN.

C. The Skagerak, Kattegat, Belt Sea and Baltic.**YOUNG STAGES****The Density and Distribution of Larvae.****Northern Kattegat and Belt Sea.**

Quantitative fishing with the 2-m. ring-trawl, carried out from S/S "Biologen" during March, i.e., in order to locate the spawning grounds of the winter herring, showed few newly hatched larvae of the winter-spawning herring in the northernmost Kattegat.

AAGE J. C. JENSEN.

Western Baltic.

Various signs suggest that the 1952 autumn brood in Kiel Bay is more numerous than in

previous years. Catches with the Petersen young-fish-trawl in January and March 1952 gave, however, on an average only 6—7 larvae per $1/2$ hour hauls. Nevertheless 200 individuals were caught per $1/2$ hour with the 1-m. ring-trawl in Kiel fjord in mid-December and since May 1953 great shoals of young herring have been observed. This has not happened for a series of years, but whether this is only a local phenomenon or an indication of the beginning of a new rich year-class will be known in the future.

R. KÄNDLER.

Table 35. Samples of 0-ringed Herrings from the southern Kattegat and the Belt Sea.

(In brackets numbers investigated. Where the year is not noted the sample is from 1952).

Locality	Month	Length, cm.	V. S.	V. P.	K ₂
Central Kattegat					
Off Mariager Fjord.....	November	8.9	56.16 (168)	24.47	14.57 (126)
— —	November	10—11	56.44 (588)	24.36	14.59 (446)
N. of Djursland.....	July—Sept.	8—11	56.45 (424)	24.17	14.23 (382)
(W. of Gerrild).....	October	7—12	56.30 (204)	24.59	14.40 (149)
Southern Kattegat					
Isefjord.....	April	9.5	55.83 (93)	23.38	13.95 (116)
Odden (Gniben).....	November	10—16	56.44 (41)	24.68	14.31 (97)
Great Belt and Little Belt					
Kalundborg Fjord.....	Jan.—Feb.	11—13	56.00 (75)	23.60	14.09 (74)
— —	Jan.—Feb.	14—16	56.18 (126)	23.81	14.40 (124)
— —	May—June	9—16	56.05 (44)	23.82	13.9 (27)
Off Kerteminde.....	December 51	11—16	56.03 (195)	23.73	14.01 (183)
— —	December 51	9—16	56.41 (269)	24.55	14.43 (258)
SE. Fyn.....	October	8—13	56.65 (66)	24.00	14.2 (27)
SW. Fyn.....	Jan.—Feb.	12.2	55.89 (204)	23.66	14.00 (210)
— —	Nov.—Dec.	13.0	56.03 (143)	23.77	14.26 (141)

COMMERCIAL FISH**Central and Southern Kattegat and Belt Sea.****The 0-group.**

Most of the samples of 0-group herring from the fishery, for fish for processing, are shown in Table 35.

If these samples are drawn into V.S.-V.P. and V.S.-K₂ diagrams it appears that most of them were mixed, and that winter spawners of the types with a high V. S. constituted a remarkably high percentage of the mixtures from the autumn of 1952, although they were dominant only in a small sample caught in the Great Belt (SE. of Fyn) in October.

In samples from off Mariager fjord and north of Djursland these winter spawners were mixed with coastal autumn spawners from the Kattegat, but Kobbergrund herring must also form a rather great part of them. In a sample from Odden in November and off Kerteminde in December the Kobbergrund herring must have constituted a great part as indicated by the high V.P.

In the Belt Sea the deep-water winter spawners were mixed with coastal spring spawners, most likely from this region, and in the samples from the Isefjord, from the Kalundborg fjord in May-June, off Kerteminde in December '51 and SW. of Fyn in January-February they were pure or almost pure coastal spring spawners. In samples from SW. of Fyn from November-December local coastal winter spawners constituted the major part or all of the herring (note the comparatively high K₂).

It is worth noting that the 0-group of the Belt Sea autumn spawners were not found in the samples investigated.

The Skagerak and Northern Kattegat.**Young herring for processing.**

As is usually the case herring of the 0-group have constituted an essential part of the fish caught for processing during the winter 1951—52 and in the autumn of 1952.

Racial analyses of samples of these herring show (see Table 36) that they were mixed. During the previous years young of autumn spawners from the western North Sea have been the main constituent, but in these samples about half of the fish were spring (winter) spawners of the Atlanto-Scandian type or possibly winter spawners from the northern Kattegat. In the sample on 3. November 1952 the races can be clearly separated from each other by dividing the material according to size-groups.

It may be noted that the autumn herring in the samples from the season 1951/52 and the summer of 1952 were of the type with a rather high V.S. (ca. 56.6), and in the samples from November 1952 of the type with V.S. ca. 56.5. In the seven samples from November a minor part of the herring were young of the Kobbergrund herring. They were taken off Frederikshavn and between Frederikshavn and Læsø Rende lightvessel.

Herring, for consumption, from the eastern Skagerak.

During January-March 1952, 5 samples of herring caught by Danish cutters in the eastern

Table 36. Length and Racial Characters of Young Herring caught for Processing near Skagen and in the Northernmost Kattegat.

(In brackets: number of herring.)

Date	No. of	Mean length	V. S.	V. P.	K ₂
1951	samples	cm.			
0 ring 17. December	1	13.2	56.67 (144)	23.97	14.77 (123)
1952					
28. Jan., 13. Feb., 9. Mar.	3	13.5	56.71 (606)	23.97	14.48 (599)
4., 9. March.	2	11.7	—	—	14.79 (443)
21., 25. July.	2	11.2	56.66 (180)	23.54	14.86 (340)
5., 6., 23. November	7	11.1	56.44 (556)	24.41	14.71 (337)
3. November	1	11.0—12.9	56.73 (101)	24.17	13.88 (60)
3. November	—	13.0—13.9	56.51 (83)	23.81	14.56 (63)
3. November	—	14.0—16.0	56.50 (72)	23.74	15.03 (64)
1 ring 28. Jan., 13. Feb.	2	16.9	56.56 (59)	23.73	15.08 (53)

Skagerak were examined; three were caught by bottom trawl at 75—95 m. depth and two by floating trawl. In the bottom trawl, the herring were caught together with varying amounts of round fish (especially saithe, whiting and cod) and in one of the catches half of the weight was fish for processing. In one of the floating-trawl catches one fifth of the total weight was mackerel.

The distributions according to maturity, length and number of winter rings are shown in Table 37, and it appears that almost half of the herrings were of maturity VII-VIII, i.e., a slightly greater percentage than in the previous season (38 %), but less than in the seasons 1948/49 and 1949/50 (62 %). The immature fish (maturities I-II) were proportionally fewer than in the previous season and at an average a little larger. They were mostly 2- and 3-ringed whereas in the 1951/52 season they were mostly 1- and 2-ringed.

The racial characters were as follows: —

Maturity	V. S.	V. P.	K ₂
I-II.	56.51 (179)	23.77	14.78 (314)
(III)-IV-V.	56.78 (55)	23.82	14.20 (55)
VII-VIII.	56.47 (352)	23.83	14.87 (350)

It will be seen that the immature and the spents and recovering spents were autumn spawners from the western North Sea.

Perhaps the immature were mixed to a small degree with coastal spring spawners which have lower V.S., V.P. and K₂, and with the Kattegat winter spawners from deep water or possibly the Atlanto-Scandian spring (winter) herring which have a higher V.S. but lower V.P. and K₂.

The major part of the herrings of maturity IV-V may seem to be deep-water winter spawners from the Kattegat but possibly they

are a mixture of Atlanto-Scandian spring (winter) spawners mixed with spring spawners from the Limfjord.

Table 37. Length and Age of Herrings caught for Consumption in the Eastern Skagerak.

Season 1951/52 (% distribution).

		Length, cm.										
		17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	Total		
Maturity												
I		0.4	6	11	7	0.1	—	—	—	—	24	
II		—	2	2	4	7	3	2	0.1	—	20	
III		—	0.1	0.4	0.7	0.3	0.1	—	—	—	2	
IV-V-VI		—	—	—	0.4	1	1	2	0.3	—	5	
VII-VIII		—	—	0.1	2	9	25	12	0.5	—	49	
Total		0.4	8	14	14	18	29	16	0.9	—	100	
		No. of rings										
		1	2	3	4	5	6	7	8	9	10	11
Maturity												
I	16	7	0.4	0.1	—	—	—	—	—	—	—	—
II	3	6	3	3	0.4	1	1	0.8	0.4	0.5	0.4	—
III	0.3	1	0.1	0.1	0.1	—	—	—	—	—	—	—
IV-V-VI	0.4	1	1	1	0.5	1	0.5	0.5	—	—	—	—
VII-VIII	2	5	7	6	6	9	9	3	—	—	—	—

The Southern Kattegat and the Belt Sea.**Herring, more than one year old.**

Apart from the fishing of large herring for consumption, a fishery for herring of about 20 cm., which are mostly used for processing and are caught with light bottom trawls of special constructions, has started in recent years. This fishery has been allowed by special license in some territorial waters (Kalundborg fjord and S. of Als) which are normally closed to trawl fishery. The whole of the material has not yet been worked up but the racial characters of the herring from most of the samples are given in Table 38.

The herring caught at Hundested (north Seeland) were typical spring spawners from

Table 33. Racial Characters of Herring with one ring and older, caught in 1952 in the southern Kattegat and the Belt Sea.

In brackets after the mean lengths: range, after the racial characters: number investigated.
P: Pound net, T: Trawl.

Locality	Gear	Month	Maturity	Length, cm.	V. S.	V. P.	K ₂
Kalundborg fjord.	T	Jan.—Febr.	I-V	ca. 21 (18—27)	56.12 (377)	23.79	14.60 (364)
— — — — —	T	May—Aug.	I-III	ca. 20 (17—27)	56.12 (509)	23.83	14.25 (451)
— — — — —	T	Sept.	I	ca. 19 (17—23)	55.97 (93)	23.67	14.19 (112)
At Hundested.	P	April	IV-VI	ca. 25 (21—29)	56.04 (159)	23.36	14.23 (154)
S. of Fyn and at Als.	P	March—April	IV-VIII	ca. 24 (19—29)	56.04 (460)	23.64	14.41 (449)
S. of Als.	T	March—April	I-III	ca. 22 (17—26)	55.65 (139)	23.95	14.15 (136)
— — — — —	T	March—April	IV-VIII	ca. 25 (20—29)	55.62 (323)	23.49	14.08 (330)

the southern Kattegat or the northern Belt Sea. Of the herring from Kalundborg fjord, those caught in January-February were mostly Kattegat coastal winter spawners, about 80 % of them were immature and 1-ringed, and the rest mostly mature 2-ringed, of the 1951 and 1950 year-classes, respectively. Those caught in May-September were spring herring from the Belt Sea or the southern Kattegat.

The pound-net herring caught south of Fyn and at Als were mostly winter herring from the Belt Sea, whereas the mature and spent herring caught in trawl south of Als were coastal spring spawners. The mature and spent herring caught by trawl south of Als were also spring spawners but the immature seem to be coastal autumn spawners from the Belt Sea. They were mostly hatched in the autumn of 1949 which corresponds to the stating of an intermixture of the 0-group herring in 1950 with Belt Sea autumn spawners (cf. Ann. Biol. VII, p. 149). Thus there may seem to be reason to hope that this year-class will show to be somewhat more numerous than the previous year-classes back to 1937.

The mature winter and spring spawners were mainly of the 1949 year-class.

Marking of herring.

At each marking of herring in 1952, the Lea hydrostatic mark and red or blue flat plastic marks fixed with nylon thread were used, in order to compare their effectivity.

Markings were carried out about 1. April at Als and SE. Fyn, and the 22. November 1952 at Copenhagen. From the last-named, where only 32 herrings were marked, no recaptures were recorded until 31. December. At the

others the number of herring marked and the percentage of recaptures until 31. December were as follows: —

	S. of Als	N. of Als	SE. Fyn
Number marked.	306	246	288
Percentage recaptured.	23	18	19

The spreading out of the herrings was about the same as was found in previous years. In each of the experiments most recaptures were not very far away from the locality of marking but from the first-named marking experiment herrings were caught north of Møen and in the northern Great Belt, from the second marking, one was caught at Warnemünde, one in the Great Belt and one off the east Jutland coast south of the Limfjord (at Hurup). From the last-named marking the herrings had spread more, two were recaptured at Rügen shortly after the marking, one in the northern Kattegat and one at the Fladen Ground in the North Sea (13/8 1952).

The Baltic Proper.

In a sample of herring caught by trawl to the north of Bornholm on 2. September, the lengths were 20—28 cm.; 75 % were mature or almost mature mostly of lengths 22—27 cm., and their racial characters were as follows (number in brackets): —

V. S.	V. P.	K ₂
55.66 (93)	23.78	14.15 (89)

Therefore it seems that they were not pure autumn spawners but that many of the maturing fish were spring spawners.

AAGE J. C. JENSEN

Shellfish.

INTRODUCTION

Contributions have been received from T. B. BAGENAL, H. BRIENNE, G. DUNCAN WAUGH, P. KORRINGA and P. F. MEYER-WAARDEN.

All the papers, with the exception of the one by Mr. BAGENAL are devoted to *Mollusca*, both oysters and mussels.

In the oyster the problems are especially the production and setting of larvae (papers by KORRINGA and WAUGH) and the saving of the spat. The spat that was already threatened by many enemies has got a new space competitor on the spat collectors in the newly intruded barnacle *Elminius modestus*. Special attention has been drawn to this species and its combating. In the paper by KORRINGA only a small part of the work done with regard to this species has been mentioned. The alarming increase of *Elminius* is shown by the statement that 100 young *Elminius* had settled on 10 cm.² spatfall slides in 3 days of exposure.

The diagrams in the papers by KORRINGA and WAUGH show the influence of different environmental conditions (temperature, rainfall, quantity of nanoplankton etc.) on the number of larvae.

Both papers demonstrate very clearly to what extent oyster culture benefits from research, and that in some respects the culture is even quite dependent on the assistance of scientific workers.

In mussel culture the assistance of scientists is also called upon especially in combating the parasite *Mytilicola intestinalis*.

In this respect, however, research cannot yet provide the means to take away the threat of this parasite. The papers by KORRINGA and MEYER-WAARDEN show that without doubt *Mytilicola* is not an innocent commensal of the mussel, as sometimes has been stated, but is a real parasite, interfering with health, growth and fattening of the mussels, and a correlation can even be demonstrated between the number of parasites and the physiological effect on the host.

The papers by MEYER-WAARDEN and KORRINGA, and the chart in the latter, demonstrate the distribution of *Mytilicola* in 1952 in the German and Dutch Waddensea. It is shown that in the Dutch Waddensea there is a slight extension in the distribution to the west. The number of parasites per mussel in the western outposts are, however, very small, and the presence of a male and a female in one mussel is of rare occurrence. It is supposed, therefore, that these outposts are not self-supporting, but that the infection is caused by larvae originating from the heavily infected mussels on both sides of the Eems estuary and transported by the tides via the North Sea.

The paper by BRIENNE shows the decrease of mussels in "le Boulonnais", a decrease that is often found in populations of *Mollusca* that are not protected by culture.

In the paper of BAGENAL a description is given of the biology of *Nephrops norvegicus* in the Clyde area.

B. HAVINGA

CRUSTACEA

Norway Lobster.

The Biology of *Nephrops norvegicus* in the Clyde Area.

Introduction.

Nephrops norvegicus (L.) is widely distributed in the Clyde area and at times is caught in considerable numbers. Since 1949 notes have been kept of its distribution, abundance and general biology, based on trawl catches and plankton collections, though for the most part these notes have been incidental to other work. However, some observations on *Nephrops* and an epizoid population of *Balanus crenatus* BRUG. have been collected and published (BARNES and BAGENAL, 1951). The present note summarizes additional information not given in the previous paper.

Population fluctuations.

Quantitative sampling of *Nephrops* is difficult. Although it is well known that the animals live in burrows, so little is known of their behaviour that it is impossible to be certain if a large catch indicates a high population density, or if the trawl has gone deeper than usual into the mud, or if for some reason the prawns have temporarily forsaken their burrows. Nevertheless from a number of hauls it is possible to get an idea of the relative abundance of *Nephrops* and to pick out any major long-term fluctuations in the population density. It has, for example, become apparent that during 1952 *Nephrops* was scarcer in the Clyde than during 1951. In 31 half-hour hauls taken in the Millport area during the period February—August 1951 646 *Nephrops* were caught while during the same months of 1952 and from the same region, 240 were obtained in 18 half-hour hauls; this gives approximately 42 and 27 *Nephrops* per hour's fishing for the periods of 1951 and 1952 respectively. There can be little doubt that the animal is less common than it was; these population changes are being followed at Millport. The planktonic larvae of *Nephrops* were also more plentiful in 1951, than in 1952. Up to about 60 specimens could be obtained in a half-hour diagonal haul with a metre net during the summer of

1951, whereas during the whole of 1952 not even a single larva was reported in any of the plankton hauls taken in the Clyde area.

The predators of *Nephrops*.

A number of stomachs from a variety of fish species have been examined in course of other investigations. *Nephrops* have only been found in those of the cod, *Gadus callarias*. Although only reported by ELMHIRST (1920¹) in 7 % of the stomachs he examined, it is clear that now cod are a much more dangerous enemy of the prawns in the Clyde, or else that *Nephrops* is more plentiful. *Nephrops* have been seen for sale in Glasgow, Rothesay and Largs. Some, which were offered in Millport sold readily, and although there is not a definite fishery for prawns in the Clyde, man is a potential enemy. At present *Nephrops* are caught incidentally by fishing boats and in all probability are eaten on board; it is very unlikely that they are liberated unless caught in very large numbers.

The fecundity and breeding of *Nephrops*.

The numbers of eggs on 30 berried females have been counted, and while it is realised that many eggs may have been lost during trawling, the results do give an indication of the numbers carried. The numbers varied from 320 on a 7 cm. female to 2633 eggs on a 15 cm. *Nephrops*; although most of the berried females were of 9—11 cm. and carried 1,000—1,600 eggs.

Berried females have been caught from August until the early spring and planktonic larvae from April to November. This indicates a long breeding season, probably associated with the long moulting period, and explains the lack of detectable year-classes in the size frequency diagrams.

For further details of the biology of the Clyde *Nephrops* reference should be made to BARNES and BAGENAL 1951: "Observations of *Nephrops norvegicus* (L.) and on an epizoid population of *Balanus crenatus* BRUG.", Journ. Mar. Biol. Assoc. **30**, 369—380.

T. B. BAGENAL

¹) Rep. Scot. Mar. Biol. Assoc.

MOLLUSCA

Oyster.

Production and Setting of Oyster Larvae in the
Rivers Roach and Crouch during 1952.

Stocks of oysters in the rivers Roach and Crouch continue to improve as a result of the relaying programme followed by the Ministry of Agriculture and Fisheries and local oyster companies. Winter losses were slight, as the weather from November 1951 to March 1952 was reasonably mild and dry. Low water samples from the upper Crouch showed that salinities dropped below 20 ‰ for five days only during this period.

Rainfall during the summer totalled 165 mm. during the period 1. June to 14. September (1951 — 216 mm.). Though rainfall was low, water temperatures were rather unfavourable, particularly in the early part of the season. In the river Roach the water had reached 17.4°C. on 17. May. On 18. May it rose to 18.2°C. and remained at this value for three days, then dropped to 17.0°C. Fluctuations continued for two weeks and then the temperature dropped slowly so that in early June it only slightly exceeded 16°C. It was not until 26. June that suitable water temperatures, above 18.0°C., were reached and maintained for any prolonged period.

Larval production.

On 30. May, when the first plankton samples were taken, oyster larvae were already common in the water, the oysters having, no doubt, been stimulated to spawn and liberate their larvae by the high temperatures in mid-May. However, it was not until mid-June that larvae appeared in quantity. At this time the temperature was above 18°C. but immediately afterwards it dropped to 16.4°C. This had an adverse effect on the growth and survival of the larvae. Very few grew to the eyed stage; it is probable that those present in the samples were the slow growing survivors from the earlier liberations.

Comparison of the graphs showing total numbers of larvae and numbers of eyed larvae, with that of the water temperature (Fig. 1),

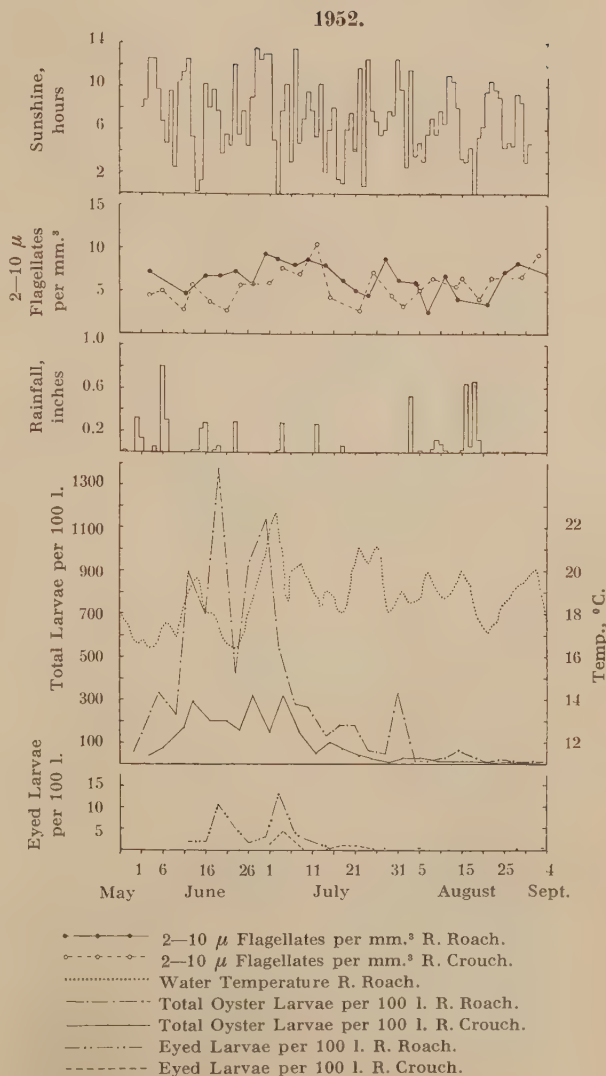


Figure 1. Graphs showing the mean daily water temperature at Paglesham in the river Roach, the total numbers of larvae per hundred litres, and numbers of eyed larvae per hundred litres and production of 2-10 μ flagellates in the rivers Roach and Crouch. Also sunshine and rainfall at Burnham during the 1952 breeding season.

shows the adverse effect of reduction in temperature when combined with poor food supplies. Some of the larvae liberated early in the season in the river Roach grew to the eyed stage and were still present on 23. June when the water temperature fell to 16.4°C. Large numbers of larvae liberated four days prior to this date failed to develop.

A further fairly heavy liberation took place from 26. to 29. June during a period of rising temperatures. At this time, as was to be expected, growth and survival were satisfactory. Eyed larvae appeared in reasonable numbers within a week.

In the river Crouch, where the density of larvae was lower, eyed individuals did not appear until 1. July but it is noteworthy that the peak numbers on 4. July coincided with those in the river Roach. It is clear that water temperature greatly influenced growth and survival during 1952.

There has been a steady increase year by year since 1947 in the larval population of the river Roach. It is in this river that restocking has been most intense. In the Crouch, where fewer oysters have been relaid, and where they are dispersed over a wider area, larval production was still poor, although a considerable improvement on the 1951 season.

Spatfall.

Judging from the numbers of eyed larvae present in the water throughout the season, it was expected that the spatfall would be similar to that experienced in 1949. At that time no reliable standard for estimating spatfall was in use. Slates, which have been exposed at fixed points in the two rivers, have been found to be unreliable, while the counting of spat on a random sample of shells from a given locality has a limited application because of the difficulty of selecting shells which have been exposed for the same length of time. The results obtained by the latter method indicated that the spatfall in the river Crouch was almost the same in the two seasons but that in the river Roach the settlement and survival in 1952 were about half those of 1949.

Egg-box collectors give a better picture of the settlement and survival of spat, as they are more uniform in surface structure, and also provide a much larger area of settling surface. Table 1 shows the average number of spat per collector in the two rivers during the years 1950 to 1952. Collectors of this type

Table 1. Average Numbers of Oyster Spat per Egg-Box Collector in the Seasons 1950, -51 and -52.

	Average number of spat per collector	
	River Roach	River Crouch
1950.....	250	150
1951.....	0.8	0.2
1952.....	62	13

were not used in 1949 but bouquets of tiles were set out in the river Roach during that year and again in 1952. The average numbers of spat per tile were 13 and 7 in 1949 and 1952 respectively.

Nanoplankton.

Observations of the fluctuations in the abundance of micro-flagellates were continued using the method first adopted in 1950 (WAUGH 1951). In 1952 the numbers of 2—10 μ flagellates did not fluctuate widely, but peak numbers in the river Roach coincided with the second larval liberation, when there was reasonable growth and survival to the eyed stage. Even so, the flagellate density was considerably less than in 1950 when there occurred the biggest spatfall in recent years. There seems little doubt that the abundance of flagellate food has a positive effect on the rate of growth and survival of the larvae. In 1951 when growth and survival of the oyster larvae was negligible, the nanoplankton population was lower in 1952. There is, therefore, a minimum level of nanoplankton production necessary for the survival of the larvae and probably this lies in the region of five 2 — 10 μ flagellates per mm.³ Above this density there is likely to be a direct relation between the rate of growth of the larvae and the numbers of flagellates, provided temperatures are suitable. If this is so, then it might be possible to encourage the growth of larvae, even in a season when water temperatures are not high, by sowing artificial fertilizers and thus encouraging the development of nanoplankton organisms.

Reference.

- WAUGH, G. D., 1951. "Production and setting of oyster larvae in the rivers Roach and Crouch during 1951, with a note on production in previous years". *Ann. Biol.*, 8, 174—178.

Larvae and Spatfall of Oysters in the Oosterschelde (Holland) in the Year 1952.

In accordance with our efforts to aid the local oyster industry by predicting the intensity of setting, plankton samples were collected and examined in 1952, and the usual observations on the number and size of oyster larvae in the water of the Oosterschelde (Holland) were made. The methods used in collecting samples have been described previously (KORRINGA 1951). The samples were collected at the Yersche Bank station in the centre of the Basin of the Oosterschelde. The frequency of sampling has been considerably higher in the summer of 1952 than in previous years, for we wanted to check the reliability of our methods once again owing to the criticism offered by LOOSANOFF and NOMEJKO (1951) concerning the phenomenon of lunar periodicity in the breeding of our oyster. Twice daily samples were taken at high slack and low slack water from 18. June up to 27. June, inclusive. On 28. June only one sample could be collected. From 30. June up to 30. July, inclusive, 4 samples have been collected daily, viz. at high slack water, at half ebb, at low slack water, and at half flood. From 31. July up to 18. August, inclusive, twice daily samples have been taken. From 19. August up to 29. August, inclusive, daily samples at high slack water. For technical reasons it was impossible to collect plankton samples on Sundays. Where two or more samples were taken in a day, the average number of larvae in each size class has been computed per 100 litres and is shown in the diagram. The intensity of setting was measured in the usual way by exposing in concrete containers lime coated glass slides at an angle of 45° for periods of 3 days. The alarming numerical increase of *Elminius modestus* DARWIN, a Balanid from the southern hemisphere intruding into British and Dutch waters, led us to collect data on its setting on our spatfall slides. To this end we added up the number of *Elminius* found on 5 cm.² of the upper surface and the number on 5 cm.² of the under surface of each slide, and the figure thus obtained is depicted in the diagram as setting of *Elminius* per 10 cm.² per period of 3 days.

With regard to the reliability of our methods of sampling, we can state that the differences between the various samples taken on one day were as a rule of limited importance.

Especially, the number of larvae of greater size was found to correspond very well. This is logical, as larvae newly arrived in the plankton will be less evenly distributed within the entire body of water than larvae which have been swimming around for several days. The diagram for 1952 (Fig. 2) does not differ fundamentally from those for previous years, and there is no reason to expect any fundamental changes in the trend by a further increase of the frequency of sampling. The greater the number of samples per day, the more one will smooth out the variations by eliminating the effect of an occasional swarm of young larvae just liberated close by, but the insignificant differences between the 1952 diagram and those for earlier years warrant the conclusion that twice-daily sampling is sufficient for our purposes, and that any periodicity obtained by combining a greater number of diagrams will be a real one. As, moreover, a combination of the diagrams for the period 1947 to 1952, inclusive, yields exactly the same result as that for the years 1937—1946, inclusive, (KORRINGA 1947, 1947a) we can conclude that lunar periodicity in the breeding of *Ostrea edulis* is a vivid reality in the Oosterschelde, and cannot be ascribed to a deficiency in our methods of sampling.

Our predictions, based on the number and size of the larvae, and on water temperatures, ran as follows: In general, (based on the size of the stock, and on lunar periodicity) an ample production of larvae was predicted, which could only in an abnormally cold summer lead to a disappointing settlement on the tiles. The maximum in the production of larvae was predicted about 2. July, but possibly a peak of some importance would be observed about 17. June. On 18. June large numbers of larvae were reported, but low water temperatures were said to slow down the development so that no spatfall was yet to be expected. This outlook was confirmed on 21. June. On 25. June a slow development of the larvae due to low water temperatures was reported, so that only few umbo larvae could be found at that time. Setting of commercial importance could not yet be announced. On 30. June it was said that a rapid increase in the water temperature would lead to a better development of the larvae so that a spatfall of commercial interest would begin about 3. or 4. July. This favourable outlook was confirmed on 1. July. On 5. July it was stated that gales and

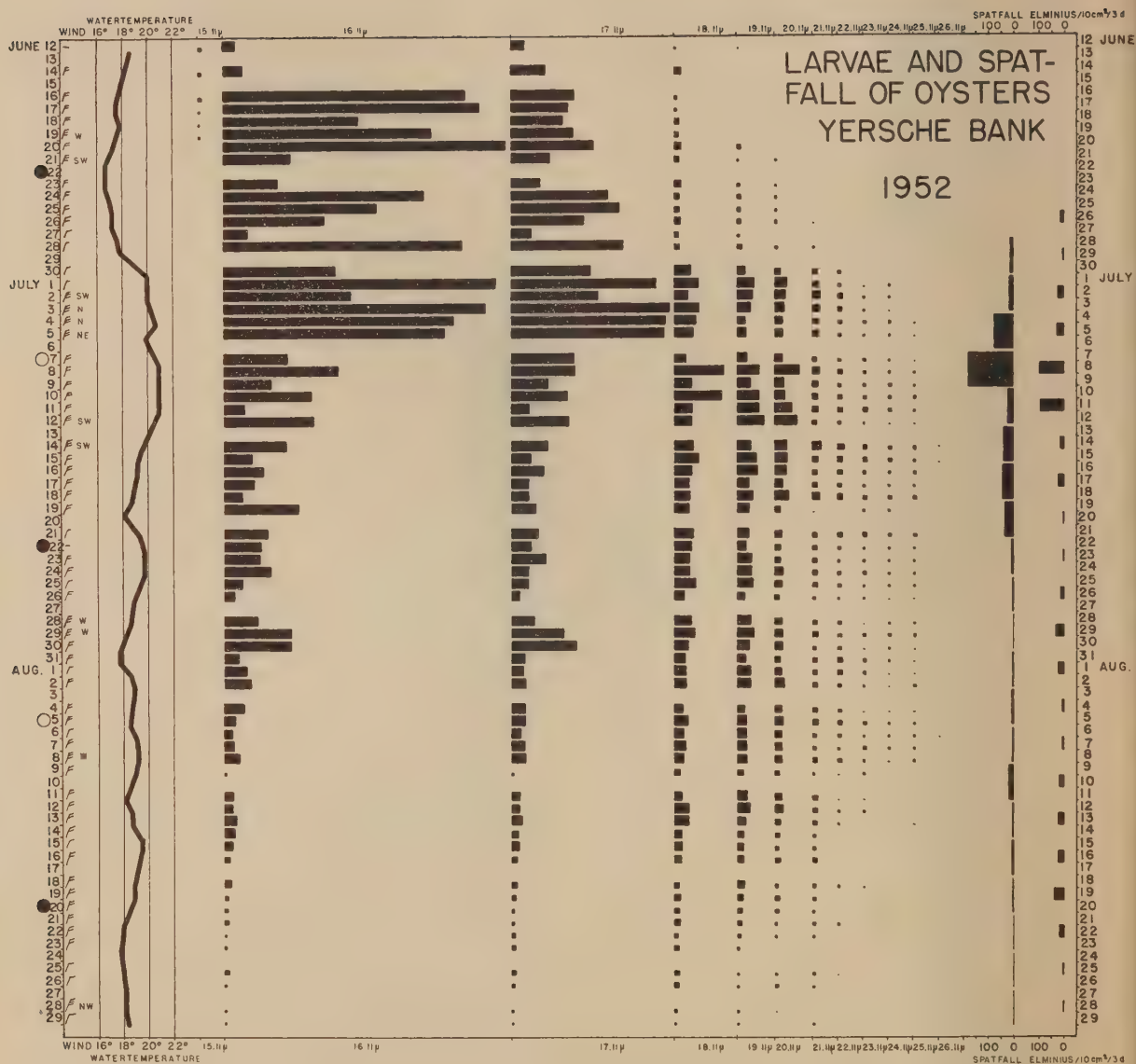


Figure 2.

heavy downpour had not led to an alarming drop in water temperature so that the oyster larvae would continue to develop well. Moreover the arrival of very great numbers of young larvae (in some samples over 2000 per 100 litres) was reported for the period 1., 2., 3. July. Evidently this was the annual maximum previously announced. A peak in the setting intensity was predicted for the next

week (about 7. to 10. July). Water temperatures remaining favourable and many umbo larvae being counted, this outlook could be confirmed on 10. July. On 18. July it was said that no doubt setting had been good in the foregoing period, and that a setting of some importance was still going on. A setting of only minor importance was announced on 24. July. On 5. August it was said that some

umbo larvae could still be found, so that a setting of limited importance could still be expected. A decrease in setting to a level well below that of commercial interest was stated on 14. August.

It can be seen from the diagram that the measured intensity of setting agreed well with our predictions. The total production of larvae has indeed been very satisfactory with its highest figures from 1. to 5. July. The previous maximum (16. to 20. June) also brought large numbers of larvae, especially of the 180 μ size class, but low water temperatures had an adverse effect on their development so that no setting of commercial interest resulted from them. The larvae produced in the period 24. to 28. June (the sample of 28. June, being a single one, may show too high a figure), but especially those liberated at the time of the maximum (1. to 5. July) developed very well and led to a good setting in the period 4. to 10. July. I fully agree with KNIGHT-JONES (1952) that especially a sudden improvement in weather conditions may lead to a favourable development of oyster larvae, much more so than a prolonged spell of fine weather. His explanation that food conditions may be poorer during prolonged fine weather when there is constant grazing by zooplankton, seems very logical. The latter cannot keep pace with nanoplankton production in periods of changeable weather.

As usual, the minor peak in larval production to be expected a fortnight after the big maximum, i.e. about 17. July, was negligible. About 30. July a fair number of larvae arrived, which led to a slight increase in setting about 10. August. The number of larvae liberated in August was very small indeed, much smaller than in August 1951 (KORRINGA 1952). Could this be attributed to the higher water temperatures in the first half of August 1951? The diagram shows that the numbers of larvae in the larger size classes were by no means as low late in July and early in August as could be expected by comparison with the numbers of young larvae, and with larval development in the first half of July. The changeable weather and perhaps, also, a lower degree of competition (fewer larvae of oysters and barnacles) may have favoured larval development late in the season.

The results obtained by the oystermen working with tile collectors were good in the year 1952, many tiles bearing over 50 spat in

autumn. However mussel shells scattered on deeper plots also collected a good deal of oyster spat. In this respect it is worth recording that no bloom of diatoms or of other phytoplankton organisms of fair size, which could smother the shells, was observed before the middle of August 1952. Also winter mortality struck the spat on the shells much heavier than that on tiles, as usual.

The setting of *Elminius* showed a peak in the period 7. to 12. July. About 100 young *Elminius* appeared to have settled on 10 cm.² of the slides in 3 days of exposure. The ratio of its setting on upper and under surfaces was on an average 3:8. For the oyster spat, this ratio was as 3:1.

The number of *Elminius* setting on tile collectors became alarming and interfered with setting and growth of oyster spat. Treatment of the tiles with D.D.T. (50 mg. D.D.T. per tile, applied as a 20 % solution in mineral oil diluted 1:30 with water, was sprayed on the tiles, which were then dried in the air) yielded such excellent results in the fight against *Elminius* in the year 1952, that it can be expected that many oystermen will apply this new method next season.

P. KORRINGA

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Coquille Saint-Jacques.

Etat de la Population de

Coquilles Saint-Jacques (*Pecten maximus* L.) en Rade de Brest en 1952, par L. FAURE.

Voir le rapport du Comité Atlantique, p. 91.

Mussel.

Investigations into *Mytilicola intestinalis* and its Attack upon the German *Mytilus* Stock in 1952.

1. Development of the epidemic in the German Wadden-sea area.

In Germany the *Mytilicola* epidemic has not, as was originally feared, extended beyond the Elbe to the mussel banks of Schleswig-Holstein. The Elbe was found to be a natural barrier.

1. The limited self-movements of the free-swimming nauplius larva of *Mytilicola* do not permit it to overcome the current of the outer Elbe. The larva develops within a few days and is therefore dependent upon suitable currents. A transport of the larva from the outer Elbe to the coastal area of Schleswig-Holstein might be possible under certain circumstances, but such a transport would last longer than the larval stage of the free-swimming form.
2. A stationary water barrier lies across the Schleswig-Holstein coast into which neither the Elbe nor the west-east current of the North Sea can enter.

We may therefore expect that in future this area will remain immune from natural infection, even though some isolated mussels infested by *Mytilicola* always do occur on the outer branches of the Schleswig-Holstein Waddensea off Friedrichskoog. Such attacks amounted in recent years generally to about 1 % with 1—2 individuals per infested mussel. Such slight attack is not sufficient to cause an extension of the epidemic in these regions.

2. Physiological investigations.

* Last year's investigations corroborate, in general, the results of former year's investigations (1—3). The harm done to the mussel consists mainly in a change of metabolism.

(a) Infestation by parasites will cause the albumen metabolism to be accelerated and the demand for oxygen to be increased (4).

(b) Simultaneously the filtering ability is diminished so that the process of nutrition is also reduced. The physiological harm resulting from parasitic infestation was the subject of last year's investigations.

1. The flesh content was remarkably lower in infested than in non-infested mussels. In the

area of the east-Frisian Waddensea the average flesh content of the infested mussels amounted to 22.6 % (fluctuating from 15.3 to 33.8 %), whereas non-infested mussels showed an average of 27.1 % (fluctuating from 17.5 to 37.5 %). The total weight taken is the fresh weight of the mussel including valves and the water of the mantle cavity.

2. The decisive factor for the decrease in the flesh percentage is the number of parasitic copepods. With an infestation by up to 3 parasites a slight decrease in the flesh is found amounting to about 5 %. With a heavier infestation, 8—10 parasites, the decrease was about 16 %. The infestation changes the chemical composition of the flesh (see Table 2), i. e., an infested mussel contains 6.4 % less albumen and 4.5 % less fat compared with a sound mussel.

Table 2. Parasitic Infestation and Chemical Composition of the Flesh of Mussels.

	(% of dry weight)		
	Albumen	Fat	Ash
Non-infested	58.2 (53.5—65.6)	6.7 (5.5—8.4)	7.6 (6.6—10.0)
Infested	55.6 (53.7—59.6)	6.4 (6.3—6.7)	8.9 (5.6—10.8)

3. The weight of the gonads is lower in the infested than in the non-infested mussels. We found the average difference to be 15—20 % — not considering the seasonal variations. In extreme cases, as in the mussels of the Borkum region, which generally lodged more than 10 parasites, the difference was often even more than 30 %. In other words, the gonads of heavily infested mussels will only reach two thirds of the normal weight; this must be considered such heavy physiological damage that under certain circumstances it may even constitute danger to the stock of the region.

Compared with last year, the intensity of the attack on the east-Frisian stock of mussels has not shown great changes. As formerly, an infestation of up to 100 % by an average of 3—8 parasites per mussel was found on the banks between Borkum and Wangerooge. In Jade bay the infestation reached 90 % and the number of parasites per mussel was 8—9. In the Waddensea of Cuxhaven (off Grimms-hörn) 10 to 20 % of the mussels were infested by about 3 parasites per mussel. The conditions on the Schleswig-Holstein side of the Meldorf bay have been mentioned above.

3. The relation between the strength of infestation and the temperature of the water.

In the spring of 1951 it seemed, at first, as if the quality of the mussels in the east-Frisian Waddensea had improved compared with the preceding year, even at a similar strength of infestation. However, during the course of summer the infested mussels exhibited the same deterioration in quality as in 1950. In the region of the Jade, for instance, on 20.4.1951 a flesh percentage of 18—20 % was ascertained (95 % infestation and 10 parasites per mussel), while on 7.7.1951 the percentage

then already begun to fatten the mussels in 1951 had a decided advantage compared to those of 1950. This advantage was, however, compensated during the summer, and *Mytilicola* parasited mussels with undiminished strength. Similar conditions seem to obtain in 1952 (MANN).

Thus we cannot talk about a decline in the epidemic in 1952. In spite of the recovery at the outset of spring, conditions in the autumn of 1952 were no better than in the warm spring of 1950.

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P. FR. MEYER-WAARDEN.

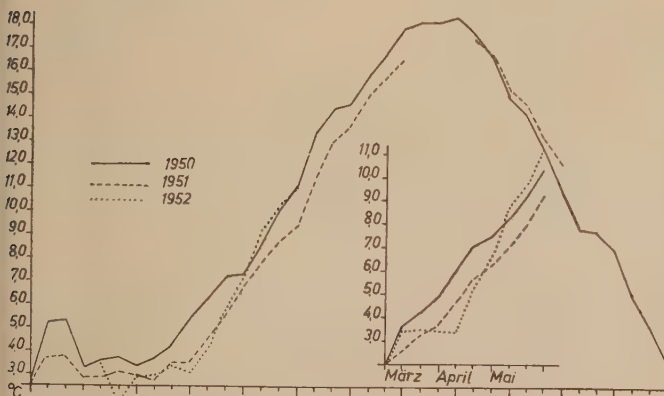


Figure 3. Yearly temperature variations at "Elbe I" and "Weser" Lightvessels.

was 12—16 % (similar to 1950 on the same spot), and in August 12—18 %. Similar observations were made in the year under review.

This fact may undoubtedly be explained through the temperature; the spring of 1950 was exceptionally mild and high water temperatures obtained, but this was not the case either in 1951 or in 1952. (Figure 3).

By the end of March and beginning of April 1950 the water temperature was 5.5° near the "Elbe I" L. V., whereas in 1951 it was only 3.5° at the same spot, and in 1952 the temperature was as low as 3°. Similar conditions prevailed at the "Weser" L. V.; the temperature curve for the corresponding period March/April 1950 was remarkably higher than those for 1951 and 1952.

The different water temperatures caused the egg production to start some 3 weeks later in 1951 and 1952 than in 1950, and consequently the new infection took place 3 weeks later in 1951 than in 1950. As the flesh had

Epidemiological Observations on the Mussel Parasite *Mytilicola intestinalis* STEUER, carried out in the Netherlands 1952.

Waddensea.

The Zeeland mussel farmers are steadily increasing their stocks of cultivated mussels in the western part of the Waddensea, situated behind the isles of Texel, Vlieland, and Terschelling. A high percentage of the marketable mussels grown in the Netherlands now comes from these waters, which are still completely free of the mussel parasite, *Mytilicola intestinalis* STEUER.

But the extensive mussel beds south and east of the German isle of Borkum, and also those of the Eemswadje (extreme eastern part of the Dutch Waddensea) are heavily infested by *Mytilicola*. Many *Mytilicola* larvae are produced in this area in the warm season. Tidal currents will transport these larvae to and fro, and some of these may find a host on the extensive natural mussel beds in the eastern part of the Dutch Waddensea. Up to 1951 the mussels west of the Eemswadje ap-



Figure 4. Waddensea, autumn 1952. Percentage of mussels infested by *Mytilicola intestinalis*.
 - - - - - western boundary, *Mytilicola*'s range in 1951.
 —→ hypothetical roads, *Mytilicola* larvae.

peared to be only very lightly infested by *Mytilicola*, i.e. 2 % or less (KORRINGA 1952). The occurrence of both a male and a female *Mytilicola* in one and the same mussel could be considered as exceptional there, so that the production of larvae was hardly worth mentioning. I therefore considered the *Mytilicola* population west of the Eemswadje as not self-supporting. Practically all the parasites found there must have been brought in as larvae by the tidal currents.

Observations in the year 1952 confirm that view. Again it is only the mussels on the Eemswadje which are heavily infested. Presumably the same will hold good for the mussels in the Borkum district (Germany). Late in the year 1952, well after termination of the breeding season, only occasional *Mytilicola* were found in wild mussels collected west of the Eemswadje. It is interesting to record (Fig. 4) that the mussels of the Spruite lodged somewhat more parasites than those of the Schild, though the latter channel is situated a shorter distance away from the Eemswadje. This confirms my hypothesis that infestation in the channels west of the Eemswadje take place with the incoming tides from the North Sea, which received its larvae from the Borkum area with the ebb currents. The finding of the highest figures close to the mouth of the channels confirms this view. This also holds

good for the Eemswadje: the highest figures are observed at the entrance of the channels leading to the tidal flats.

A difference from the year 1951 is that *Mytilicola* has been found further west in 1952: light and very light infestations have been observed in the Eilander Balg and near the mouths of Siege and Zoutkamper Laag (Fig. 4). Production of larvae which may threaten the important mussel districts further west, until now will have been hardly worth mentioning in the area west of the Eemswadje. Where one finds on an average 1 *Mytilicola* in every 50 or in every 100 mussels, one can expect a male and a female living together in about 1 out of 5000 or in 1 out of 20,000 mussels respectively. Few if any of the larvae produced by these couples will have been responsible for the infestations found in 1952. The higher figures observed in the Spruite and the complete absence of *Mytilicola* in the Schildknopen (Fig. 4 Sch.kn.) confirm the view that the larvae have not been transported east-west over the tidal flats, but will have arrived with the incoming tide from the North Sea.

It seems possible that next season may show a retreat of *Mytilicola* from Zoutkamper Laag and Eilander Balg, as the older parasites will die off, and as the number of new larvae coming in will differ from year to year. We should, however, not be too confident in this.

Danger threatens without doubt. I already consider the number of *Mytilicola* in the Spruite so high (0 to 8 % of the mussels infested) that any increase may lead to a dangerous production of larvae there. Further, it is possible that until now uncharted natural mussel beds occur in the North Sea off the Wadden Islands, and that these act as a nidus of infestation. It is certainly of great importance to keep the eastern part of the Dutch Waddensea under constant supervision, and to plan counterthrusts (eradication of entire mussel populations) whenever the situation becomes alarming.

Zeeland.

The events in the Zeeland waters in the year 1952 resemble those observed in the year 1951 in many respects. Once again the total quantity of mussels grown in the Zeeland waters fell far behind that of the fatal year 1950, as many musselmen concentrated on farming in the Waddensea. This entailed a modest total production of *Mytilicola* larvae in the spring of 1952 as compared with 1950. Moreover the chance of the larvae finding a host decreases with the decline in the total number of mussels. Further it was fortunate that water temperatures were rather low in the spring of 1952 (Table 3). It could be confirmed that the critical temperature for spawning in *Mytilicola* is 7 to 8° C. Late in March females carrying eggs were extremely rare. Early in April the first eggs were found in the Geul, O. S. O. D., a district which always warms

Table 4. Correlation between the Number of *Mytilicola* and Growth in Mussel-Seed.

Mussel-seed fished in the Waddensea (free of *Mytilicola*) and relaid in Zeeland winter 1951–1952. Size and condition late in August 1952, as compared with the number of *Mytilicola* per mussel. Condition of meat indicated as "good", "fair", and "lean" in percentages.

Group	District	Average No. of		Condition			Size lean mm.
		No. of plots	<i>Mytilicola</i> per Mussel	good	fair %	lean	
A	Grevelingen..	173	1.4	40	60	0	45
	Brab. Vaarw..	78					
	Hammen	52					
	Hammen	11					
B	Geul O.S.O.D.	500	2.2	38	57	5	41
	Herk. Bank..	10					
	Herk. Bank..	20					
	Dortsmann....	97					
	Roompot....	105					
C	Geul O.S.O.D.	503	4.4	11	83	6	40
	Geul O.S.O.D.	432					
	Hals Grev. ..	63					
	Hals Grev. ..	49					
	Hals Grev. ..	58					
	Dortsmann....	121					
	Zandkreek...	67					
D	Geul O.S.O.D.	462	8.6	5	77	18	37
	Zandkreek...	57					

up more readily than any of the other Zeeland mussel areas. It was not before the middle of April that egg-bearing females were observed in the other districts. Late in April a high percentage of the female parasites appeared to carry eggs, those in the Geul being ready to hatch. Though fair numbers of larvae must have been liberated in May, only very modest numbers of young parasites could be found in the mussels at the end of that month. The mussels suffered little, if at all. Even in June relatively few young parasites made their appearance. The old parasites which had hibernated as adults died off in the month of July. Fair numbers of young *Mytilicola* made their appearance in that month, and those born in May already approached sexual maturity. The latter, together with the parasites which had hibernated as juveniles gave rise to a rapid numerical increase in August and September.

As usual the percentage of mussels becoming infested and the number of *Mytilicola* per mussel showed considerable differences from place to place. Dangerous numbers seriously interfer-

Table 3. Water Temperatures in the eastern Part of the Oosterschelde, °C.

	1950	1951	1952
January.....	3.5	2.5	3.6
February.....	3.8	3.9	2.5
March (1st 10 days).....	5.4	4.5	4.7
March (2nd do.)	6.9	5.9	5.5
March (3rd do.)	7.6	5.7	5.7
April (1st do.)	8.1	6.7	6.1
April (2nd do.)	8.7	7.5	11.0
April (3rd do.)	9.1	9.7	11.7
May (1st do.)	10.5	10.6	13.8
May (2nd do.)	13.3	11.3	15.4
May (3rd do.)	15.0	14.2	15.5
June.....	18.9	17.2	17.0
July.....	20.0	19.0	19.2
August.....	19.5	18.9	19.1
September.....	15.6	17.3	14.7
October.....	11.8	12.1	10.5
November.....	7.1	10.3	6.4
December.....	3.5	5.8	2.1

Table 5. Characteristic Events in 1952 in

A. Plots in districts with light infestation in 1952.

Plot 105 Roompot (Hammen, O. S. W. D.). Mussel-seed from the Westerschelde, relaid September 1951.

Date of sampling	Size mussels mm.	% infested	Number of total	Mytilicola per mussel			Condition
				♀ (bearing eggs)	♂	juvenile	
17. March.....	33	0	—	—	—	—	0/100/0
15. April.....	33	0	—	—	—	—	0/100/0
28. April.....	33	0	—	—	—	—	0/100/0
12. May.....	35	0	—	—	—	—	0/100/0
26. May.....	38	0	—	—	—	—	0/100/0
23. June.....	39	0	—	—	—	—	0/100/0
4. August.....	41	90	2.8	1.6 (0.7)	0.8	0.4	55/ 45/0
26. August.....	47	75	2.3	0.8 (0.3)	1.3	0.2	100/ 0/0
22. September.....	49	95	3.7	1.6 (0.9)	1.6	0.5	85/ 15/0
24. November.....	54	85	5.5	2.4 (0.5)	2.4	0.7	40/ 60/0

Plot 52 Hammen, O. S. W. D. Mussel-seed from the Waddensea, relaid May 1952.

23. June.....	28	0	—	—	—	—	0/100/0
4. August.....	38	60	2.1	0.9 (0.5)	0.6	0.6	5/ 95/0
26. August.....	42	65	1.6	0.7 (0.3)	0.8	0.1	40/ 60/0
22. September.....	43	75	2.5	1.3 (0.6)	0.8	0.4	100/ 0/0
24. November.....	48	95	5.7	2.0 (0.6)	2.6	1.1	15/ 85/0

Plot 20 Herkingsche Bank (Grevelingen). Mussel-seed from the Waddensea, relaid October 1951.

16. March.....	24	0	—	—	—	—	0/100/0
15. April.....	25	0	—	—	—	—	0/100/0
28. April.....	28	0	—	—	—	—	0/100/0
26. May.....	31	0	—	—	—	—	0/100/0
30. June.....	37	0	—	—	—	—	0/100/0
5. August.....	41	70	1.0	0.4	0.4	0.2	5/ 95/0
25. August.....	45	80	2.4	1.2 (0.6)	0.9	0.3	80/ 20/0
29. September.....	44	80	2.6	1.0 (0.5)	1.1	0.5	35/ 65/0
10. December.....	52	95	5.9	1.9 (0.1)	2.9	1.1	65/ 35/0

B. Plots in districts with moderate infestation in 1952.

Plot 63 Grevelingen. Young mussels from natural beds in Noordergat, slightly infested by *Mytilicola* autumn 1951, relaid September 1951.

Date of sampling	Size mussels mm.	% infested	No. of total	Mytilicola per mussel			Condition
				♀ (bearing eggs)	♂	juvenile	
16. March.....	31	15	0.3	0.1	0.1	0.1	0/100/0
15. April.....	30	15	0.2	0.1	0.1	—	0/100/0
28. April.....	31	35	0.5	0.4 (0.1)	0.1	—	0/100/0
26. May.....	34	55	0.8	0.7 (0.2)	0.1	—	0/100/0
30. June.....	35	70	1.6	0.6 (0.2)	0.3	0.7	0/100/0
5. August.....	41	90	5.6	2.4 (0.7)	1.9	1.3	20/ 80/0
25. August.....	43	95	5.8	2.0 (1.0)	3.5	0.3	20/ 80/0
29. September.....	45	90	6.0	1.5 (0.8)	3.3	1.2	40/ 60/0
10. December.....	48	95	8.6	3.3 (0.1)	3.4	1.9	70/ 20/10

ing with health, growth and fattening of the hosts were only observed in the districts Geul O. S. O. D., Zandkreek, and Dortsman, where the mussel populations are dense. In the district Hammen O. S. W. D., on the other hand, the number of mussels per volume of water is much lower and the infestation did not

reach alarming levels. The mussels there grew and fattened almost normally. A comparison of growth and general condition of young mussels fished in the Waddensea and relaid on the Zeeland plots in the winter season 1951/1952 demonstrated, however, that even light and recent infestations, which do not

different Parts of the Zeeland Waters.

Plot 23 *Herkingsche Bank (Grevelingen)*. Young mussels from natural beds in the Steenbergse Vliet, relaid August 1951 and then slightly infested by *Mytilicola*.

Date of sampling	Size mussels mm.	% infested	Number of total	<i>Mytilicola</i> per mussel			Condition
				♀ (bearing eggs)	♂	juvenile	
16. March.....	28	50	0.9	0.5	—	0.1	0/100/0
15. April.....	32	45	1.1	0.6	—	0.4	0/100/0
28. April.....	32	45	0.8	0.4	—	0.2	0/100/0
26. May.....	35	30	0.4	0.2	—	0.2	0/100/0
30. June.....	39	40	0.7	0.1	—	0.3	0/100/0
5. August.....	44	70	2.5	1.1	(0.3)	1.1	20/ 80/0
29. September.....	47	70	2.6	0.4	(0.3)	0.9	75/ 25/0
10. December.....	49	95	8.7	2.1	—	4.0	70/ 25/5

Plot 114 *Dortman*, O. S. W. D. Half-grown mussels transplanted from plot 466 Geul (O. S. O. D.) February 1952. Moderate infestation late in 1951.

17. March.....	44	100	8.4	2.8	—	4.6	1.0	25/ 50/25
15. April.....	44	100	8.3	3.2	(0.6)	4.2	0.9	0/ 90/10
28. April.....	45	100	8.7	2.7	(0.9)	5.6	0.4	0/100/0
26. May.....	45	95	8.6	2.9	(1.8)	5.7	—	20/ 70/10
23. June.....	47	80	3.6	0.9	(0.6)	2.7	—	20/ 75/5
4. August.....	47	95	5.9	1.2	(0.4)	3.4	1.3	45/ 55/0
22. September.....	47	95	6.9	0.9	(0.6)	3.2	2.8	80/ 20/0
24. November.....	49	100	9.6	1.9	(0.2)	3.4	4.3	75/ 20/5

C. Plots in districts heavily infested by *Mytilicola* in 1952.

Plot 97 *Dortman*, O. S. W. D. Mussel-seed from the Waddensea, relaid October 1951.

17. March.....	20	0	—	—	—	—	—	0/100/0
15. April.....	23	0	—	—	—	—	—	0/100/0
28. April.....	25	0	—	—	—	—	—	0/100/0
12. May.....	27	0	—	—	—	—	—	0/100/0
26. May.....	30	0	—	—	—	—	—	0/ 85/15
23. June.....	33	15	0.2	0.1	—	0.1	—	0/ 85/15
4. August.....	37	85	2.4	1.0	(0.2)	0.7	0.7	0/100/0
26. August.....	37	85	3.1	1.7	(0.4)	1.3	0.1	10/ 80/10
22. September.....	40	95	6.2	1.8	(1.0)	2.2	2.2	5/ 90/5
24. November.....	40	100	14.1	2.9	(1.0)	4.4	6.8	0/ 50/50

Plot 462 *Geul*, O. S. O. D. Mussel-seed from the Waddensea, relaid May 1952.

20. August.....	33	100	8.4	3.4	(1.6)	3.8	1.2	0/65/35
22. September.....	34	100	10.7	2.2	(1.2)	3.8	4.7	0/ 5/95
25. November.....	35	100	16.0	3.3	(1.0)	5.3	7.4	0/15/85

Plot 107 *Zandkreek*. Mussel-seed from the Westerschelde, relaid September 1951.

17. March.....	39	0	—	—	—	—	—	0/100/0
15. April.....	40	0	—	—	—	—	—	0/100/0
28. April.....	41	0	—	—	—	—	—	0/100/0
26. May.....	43	0	—	—	—	—	—	0/100/0
23. June.....	47	25	0.3	0.1	—	—	0.2	35/ 65/0
4. August.....	50	90	7.3	2.0	(0.4)	2.0	3.3	40/ 50/10
22. September.....	53	100	12.4	4.3	(1.5)	5.3	2.8	45/ 55/0
24. November.....	54	100	22.4	5.9	(1.2)	7.2	9.3	35/ 65/0

lead to serious symptoms and death of the host, interfered with its growth and condition (Table 4).

Though the autumn of 1952 was much colder than usual, *Mytilicola*'s reproduction did not come to a standstill before the middle of November. Many young parasites made their

appearance in the month of October. They did not grow up fast and will hibernate as juveniles. This means that most probably they will not die off in June and July 1953, but will go on producing offspring. The observation of *Mytilicola*'s success in reproduction at low water temperatures together with the fact that

Tableau 6. Mensurations des Moules effectuées en Mars 1953.

Taille en mm.	A. «La Pointe-aux-Oies» N = 1209		«Cap d'Alprech» N = 3176		B. «La Pointe-aux-Oies»			
					Partie haute N = 633		Partie basse N = 576	
	Nombre	‰	Nombre	‰	Nombre	‰	Nombre	‰
5—9.....	35	29	413	130	34	53	1	2
10—14.....	115	95	717	226	91	143	24	41
15—19.....	148	122	755	238	75	118	73	127
20—24.....	164	136	525	165	76	120	88	153
25—29.....	255	211	376	118	152	240	103	179
30—34.....	290	240	212	67	154	243	136	236
35—39.....	160	132	121	38	47	74	113	196
40—44.....	39	32	53	17	3	5	36	62
45—49.....	3	2	4	1	1	2	2	3

certain plots suffer much more from the infestation than neighbouring plots, leads to the tentative conclusion that its pelagic life is not necessarily of long duration. Some larvae, at least, may find a new host shortly after entering the plankton. This was corroborated by laboratory observations.

All our observations warrant the conclusion that *Mytilicola intestinalis* is not just an innocent commensal of the mussel, but a true parasite, interfering with health, growth and fattening of the host. The parasite is active in the warmer season only, and in a dormant stage, showing no growth at all, in winter. High numbers of parasites may in the warmer season lead to typical symptoms of ill health of the host, leading in serious cases to the latter's death. Low numbers of *Mytilicola* have an adverse effect on the mussel's growth and fattening. No evidence can be adduced to support DOLLFUS' hypothesis that *Mytilicola* is a harmless creature. The inclination of some mussel-farmers to adopt this same view is a case of wishful thinking.

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P. KORRINGA.

Observations sur le Stock

de Moules (*Mytilus edulis*) du Boulonnais.

I. Lieux et conditions de prélèvement du matériel étudié.

Les moules étudiées proviennent de gisements situés à quelques kilomètres au nord (lieu dit «La Pointe-aux-Oies») et au sud de Boulogne-sur-Mer («Cap d'Alprech»).

Elles ont été prélevées au début du mois de Mars, à raison d'une dizaine de petits prélèvements effectués d'une part dans la partie haute, soumise à une immersion réduite, et d'autre part dans la partie basse, soumise à une immersion prolongée, de chacun des gisements.

II. Observations.

Les observations ont permis notamment:

- une étude du stock actuel des moules du Boulonnais,
- une étude comparative des moules provenant de gisements différents.

1. Stock actuel des moules du Boulonnais.

La répartition par tailles des moules prélevées (Fig. 5) indique la prédominance presque totale, tant sur les gisements situés au nord de Boulogne que sur ceux situés au sud, de moules inférieures à la taille marchande de 40 mm. Elle met également en évidence une différence dans la répartition des tailles suivant les gisements: sommet à 30—34 mm., pour «La Pointe-aux-Oies», et à 15—19 mm., pour le «Cap d'Alprech».

La répartition des moules sur un même gisement, d'autre part, est différente suivant les emplacements considérés. L'exemple de «La Pointe-aux-Oies» (Fig. 6) montre que la quantité de moules de taille marchande est plus grande dans la partie basse (B) que dans la partie haute (A) de ce gisement.

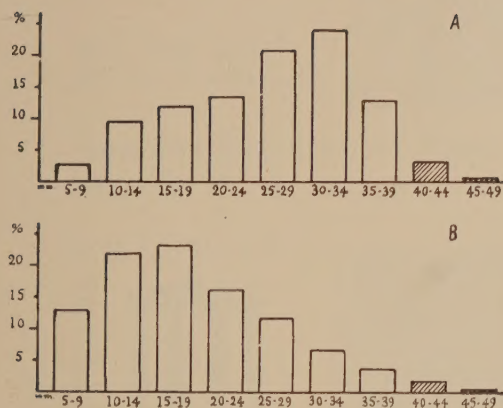


Figure 5.

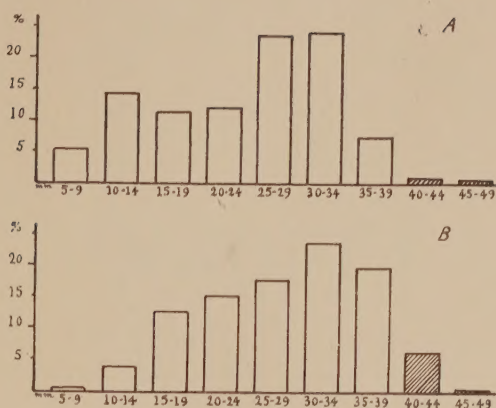


Figure 6.

Les résultats des mensurations effectuées au cours du mois de Mars 1953 sont résumés dans le Tableau 6. Dans ce même tableau, sont portées les mensurations des moules des parties haute et basse de «La Pointe-aux-Oies».

2. Etude comparative des moules provenant de gisements différents.

Les moules examinées ont été mesurées suivant leurs trois dimensions: longueur (L) — largeur (l) — épaisseur (e), à l'aide desquelles des rapports: $\frac{L}{l}$, $\frac{L}{e}$, $\frac{l}{e}$, ont été établis et réunis dans le Tableau 7.

Tableau 7.

	«La Pointe-aux-Oies»		«Cap d'Alprech»	
	Partie haute	Partie basse	Partie haute	Partie basse
$\frac{L}{l}$	2.11	2.20	2.05	2.10
$\frac{L}{e}$	2.30	2.92	2.04	2.77
$\frac{l}{e}$	1.09	1.33	0.99	1.32

Ces rapports montrent que l'épaisseur des moules de la partie haute des gisements est plus grande que celle des moules de la partie basse. Ces moules, longtemps exposées à l'air, ont une croissance lente marquée par de fortes stries; l'épaisseur de la moule est sensiblement égale à sa largeur.

Par contre les caractères morphologiques (rapports $\frac{L}{l}$, $\frac{L}{e}$, $\frac{l}{e}$) des moules des parties hautes de chacun des gisements sont semblables. Il en est de même pour les caractères morphologiques des moules des parties basses de chacun de ces gisements.

III. Conclusions.

Les gisements de moules du Boulonnais ont été considérablement appauvris pendant et après la guerre. L'étude biométrique du stock montre que ces gisements, autrefois réputés, n'ont plus aujourd'hui qu'une valeur économique insignifiante.

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